The 1999 National Household Survey on Drug Abuse

Sample Design Report

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Chapter 1: Overview

1.1 Target Population

The respondent universe for the 1999 National Household Survey on Drug Abuse (NHSDA) was the civilian, noninstitutionalized population aged 12 years or older residing within the United States and the District of Columbia. Consistent with the NHSDA designs since 1991, the 1999 NHSDA universe included residents of noninstitutional group quarters (e.g., shelters, rooming houses, dormitories, and group homes), residents of Alaska and Hawaii, and civilians residing on military bases. Survey coverage before the 1991 NHSDA was limited to residents of the coterminous 48 states and it excluded residents of group quarters and all persons (including civilians) living on military bases. Persons excluded from the 1999 universe included those with no fixed household address (e.g., homeless transients not in shelters) and residents of institutional group quarters, such as jails and hospitals.

1.2 Design Overview

The Substance Abuse and Mental Health Administration (SAMHSA) implemented major changes in the way the NHSDA would be conducted beginning in 1999 and continuing through subsequent years. The 1999 survey was the first conducted using computer-assisted interviewing (CAI) methods. This survey also marked the first year in a transition to improved state estimates based on minimum sample sizes per state. In addition, it was also the first year in which cigarette brand information was obtained for the Centers for Disease Control and Prevention (CDC). To obtain the required precision at the state level and to improve the precision of cigarette brand data for youth at the national level, the total sample size was increased by 2,500 youths aged 12 to 17 to a total of 70,000. This large sample size allowed SAMHSA to continue reporting adequately precise demographic subgroups at the national level without needing to oversample specially targeted demographics, as was required in the past. This large sample is referred to as the "main sample" or the "CAI sample." The achieved sample for the 1999 CAI sample was 66, 706 persons.

To maintain estimates of trends over time on a comparable survey mode basis, a nationally allocated sample supplement was also be fielded in 1999. For this sample, paper and pencil interviewing (PAPI) was employed to maintain comparability with previous years for trend estimation purposes. This sample will be used to adjust prior years' estimates to make them comparable with estimates obtained using the CAI methodology. This sample is referred to as the "supplemental sample" or the "PAPI sample." A sample size of 20,000 persons comparable to recent years' national samples was planned for the supplemental sample. However, after two quarters of data collection, a decision was made to adjust the targeted sample size down to 15,000. Quarter 1 of the 1999 survey was yielding a larger-than-expected number of interviews, thus the targeted sample size was adjusted to 4,500 in quarter 2. Then, in quarters 3 and 4 the targeted sample size was set at 2,500. Therefore, the actual achieved sample for the 1999 PAPI sample was 13,809.

1.2.1 5-Year Design

A coordinated 5-year sample design was developed. Both the 1999 main sample and the 1999 supplemental sample are subsamples of the 5-year sample. Although there is no overlap with the 1998 sample, a coordinated design for 1999-2003 facilitated 50% overlap in first- stage units (area segments) between each two successive years from 1999 through 2003. This design was intended to increase the precision of estimates in year-to-year trend analyses because of the expected positive correlation resulting from the overlapping sample between successive NHSDA years.

The 1999-2003 design provides for estimates by state in all 50 states plus the District of Columbia. States may therefore be viewed as the first level of stratification as well as a reporting variable. Eight states, referred to as the "big" states,[1] had a sample designed to yield 3,600 to 4,630 respondents per state for the 1999 survey. This sample size was considered adequate to support direct state estimates. The remaining 43 states,[2] had a sample designed to yield 900 to 1,030 respondents per state in the 1999 survey. In these 43 states, adequate data were available to support reliable state estimates based on small area estimation methodology. The youth supplement was allocated to the larger population states to increase precision of smoking-related estimates for youth at the national level.

Within each state, field interviewer (FI) regions were formed. Based on a composited size measure, states were geographically partitioned into roughly equal size regions. In other words, regions were formed such that each area yielded, in expectation, roughly the same number of interviews during each data collection period, thus distributing the workload equally among NHSDA interviewers. The smaller states were partitioned into 12 FI regions, whereas the eight "big" states were divided into 48 regions. Therefore, the partitioning of the United States resulted in the formation of a total of 900 FI regions. FI region maps can be found in Appendix A.

For the first stage of sampling, each of the FI regions was partitioned into noncompact clusters[3] of dwelling units by aggregating adjacent Census blocks. Consistent with the terminology used in previous NHSDAs, these geographic clusters of blocks are referred to as *segments*. A sample *dwelling unit* in the NHSDA refers to either a housing unit or a group-quarters listing unit such as a dormitory room or a shelter bed. To support the overlapping sample design and any special supplemental samples or field tests that SAMHSA may wish to conduct, segments were formed to contain a minimum of 175 dwelling units[4] on average. In prior years, this average minimum segment dwelling unit size was only 90.

Before selecting sample segments, additional implicit stratification was achieved by sorting the first-stage sampling units by an MSA/SES (socioeconomic status) indicator[5] and by the percent of the population that is non-Hispanic and white. From this well-ordered sample frame, 96[6] segments per FI region were selected with probabilities proportionate to a composite size measure and with minimum replacement. The selected segments were then randomly assigned to a survey year and quarter of data collection as will be

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[1]For the 1999-2003 NHSDAs, the "big" states are California, Florida, Illinois, Michigan, New York, Ohio, Pennsylvania, and Texas.

[2]For reporting and stratification purposes, the District of Columbia is treated the same as a state and no distinction is made in the discussion.

[3]Noncompact clusters (selection from a list) differ from compact clusters in that not all units within the cluster are included in the sample. While compact cluster designs are less costly and more stable, a noncompact cluster design was used because it provides for greater heterogeneity of dwellings within the sample. Also, social interaction (contagion) among neighboring dwellings is sometimes introduced with compact clusters (Kish 1965).

[4]Dwelling unit counts were obtained from the 1990 Decennial Census data supplemented with revised population counts from Claritas.

[5]Four categories are defined as: (1) MSA/low SES, (2) MSA/high SES, (3) Non-MSA/low SES, and (4) Non-MSA/high SES.

[6]The 1999-2003 sample was planned such that 48 segments per FI region would be selected. In the implementation, however, an additional 48 segments were added to support any supplemental or field test samples.

described in Section 2.4. Twenty-four of these segments were designated for the coordinated 5-year sample, while the other 72 were designated as "reserve" segments.

1.2.2 Main Sample

Once sample segments for the 1999 NHSDA were selected, specially trained field household listers visited the areas and obtained complete and accurate lists of all eligible dwelling units within the sample segment boundaries. These lists served as the frames for the second stage of sample selection.

The primary objective of the second stage of sample selection (listing units) was to determine the minimum number of dwelling units needed in each segment to meet the targeted sample sizes for all age groups. Thus, listing unit sample sizes for the segment were determined using the age group with the largest sampling rate, which we refer to as the "driving" age group. Using 1990 Census data adjusted to more recent data from Claritas, state and age-specific sampling rates were computed. These rates were then adjusted by the segment's probability of selection, the subsegmentation inflation factor,[7] if any, the probability of selecting a person in the age group (equal to the maximum or 0.99 for the driving age group), and an adjustment for the "maximum of two" rule.[8] In addition to these factors, historical data from the 1997 NHSDA were used to compute predicted screening and interviewing response rate adjustments. The final adjusted sampling rate was then multiplied by the actual number of dwelling units found in the field during counting and listing activities. The product represents the segment's listing unit sample size.

Some constraints were put on the listing unit sample sizes. For example, to ensure adequate sample for the overlapping design and/or for supplemental studies, the listing unit sample size could not exceed 100 or half of the actual listing unit count. Similarly, beginning in quarter 3, a minimum of five listing units per segment was required for cost efficiency.

Using a random start point and interval-based (systematic) selection, the actual listing units were selected from the segment frame. After dwelling unit selections were made, an interviewer visited each selected dwelling unit to obtain a roster of all persons residing in the dwelling unit. As in previous years, during the data collection period, if an interviewer encountered any new dwelling unit in a segment or found a dwelling unit that was missed during the original counting and listing activities, then the new/missed dwellings were selected into the 1999 NHSDA using the half-open interval selection technique.[9] The selection technique eliminates any frame bias that might be introduced because of errors and/or omissions in the counting and listing activities and also eliminates any bias that might be associated with using "old" segment listings.

Using the roster information obtained from an eligible member of the selected dwelling unit, 0, 1, or 2 persons were selected for the survey. Sampling rates were pre-set by age group and state. Roster

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[7]Segments found to be very large in the field are partitioned into *subsegments*. Then, one subsegment is chosen at random with probability proportional to size to be fielded. The subsegmentation inflation factor accounts for the narrowing down of the segment.

[8]Brewer's Selection Algorithm never allows for greater than two persons per household to be chosen. Thus, sampling rates are adjusted to satisfy this constraint.

[9]In summary, this technique states that, if a dwelling unit is selected for the 1999 study and an interviewer observes any new or missed dwelling units between the selected dwelling unit and the dwelling unit appearing immediately after the selection on the counting and listing form, then all new/missed dwellings falling in this interval will be selected. If a large number of new/missed dwelling units are encountered (generally greater than six), then a sample of the missing dwelling units will be selected.

information was entered directly into the electronic screening instrument, which automatically implemented this third stage of selection based on the state and age group sampling parameters.

One exciting consequence of using an electronic screening instrument in the NHSDA is the ability to impose a more complicated person-level selection algorithm on the third stage of the NHSDA design. In 1999, one feature that was included in the design was that *any* two survey-eligible people within a dwelling unit had some chance of being selected, i.e., all survey eligible pairs of people had some nonzero chance of being selected. This feature of the 1999 design was of interest to NHSDA researchers because, for example, it allows analysts to examine how the drug use propensity of one individual in a family relates to the drug use propensity of other family members residing in the same dwelling unit (e.g., the relationship of drug use between a parent and his/her child).

1.2.3 Supplemental Sample

To maximize precision between the main study CAI estimates and estimates generated from the PAPI supplemental sample, the design of the supplemental sample closely mirrored that of the main study with an additional level of clustering imposed at the first stage of selection. This additional clustering was introduced to minimize the costs associated with collecting the supplemental data by minimizing the number of interviewers that needed to be trained on the PAPI instrument. Unlike the main study but similar to prior year designs, the supplemental sample was designed to oversample Hispanics and blacks (as well as younger individuals) to maximize contrast estimates for these important subpopulations of interest. Finally, the 1999 supplemental sample allocation to age groups was matched to prior-year allocations to facilitate efficient trend estimation.

The initial stage of selection entailed subselecting 250 FI regions from among the 900 FI regions defined for the main study. These FI regions were selected randomly within strata that were defined to isolate relatively high concentrated Hispanic areas, high concentrated black areas, high concentrated white areas, and the remainder areas. This race/Ethnic-based stratification was imposed to optimally sample Hispanics and blacks at the last stage of selection and is further described in Table 1.1.

Table 1.1 Stratum Definitions for the PAPI Supplemental Study

Stratum	Definition
Stratum 1	High concentration of Hispanic FI regions. These regions had a 50% or more Hispanic population.
Stratum 2	High concentration of black FI regions. These regions had a 50% or more black, non-Hispanic population.
Stratum 3	High concentration of minority FI regions. These regions had a 50% or more minority (Hispanic plus black) population and could not fall into either stratum one or two.
Stratum 4	High concentration of white FI regions. These regions had a 90% or more white population.
Stratum 5	Medium concentration of white FI regions. These regions had between a 75% and 90% white population.
Stratum 6	Remainder of FI regions. These FI regions had a 0 to 50% black population, a 0 to 50% Hispanic population, and a 50% to 75% white population.

After the 250 FI regions were subselected, at the second stage of selection all those segments that were selected for the main study sample within these regions were also selected for the supplemental sample. The main study probabilities of selection apply here since segments were randomly selected from within the main study FI region strata. This complete segment overlap between the main study and supplemental sample within the 250 FI regions provides for the maximal amount of precision in contrast estimates between the two samples.

Within each segment, at the third stage of selection a sample of dwelling units was selected from among those not selected for the main study. The line sample size determination for the supplemental sample closely resembled that of the main study. In the supplemental sample, however, design stratum, age group and race were considered instead of state and age.

Similar to the main study, at the fourth stage of selection for the supplemental sample, either zero, one, or two people were selected from within each successfully screened dwelling unit. As with the main study, any pair of survey-eligible residents within the dwelling unit had some known, nonzero chance of being selected for the survey.

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Chapter 2: The Coordinated 5-Year Sample

As was previously mentioned, the sample design was simultaneously developed for the 1999-2003 NHSDAs. Starting with a Census block level frame, first stage sampling units or area segments were formed. A sufficient number of segments was then selected to support the 5-year design as well as any supplemental studies SAMHSA may choose to field.

2.1 Formation of and Objectives for Using the Composite Size Measures

The composite size measure procedure is used to obtain self-weighting samples for multiple domains in multistage designs. The NHSDA sample design has employed the composite size measure methodology since 1988. Our goal was to specify size measures for sample areas (segments) and dwelling units that achieve the following objectives:

- Yield the targeted domain sample sizes in expectation (E_s) over repeated samples; that is, if m_{ds} is the domain-d sample size achieved by sample-s, then

$$E_s(m_{ds}) = m_d \text{ for } d=1,...,D. \quad (1)$$

- Constrain the maximum number of selections per dwelling unit at a specified value; specifically, we limit the total number of within-dwelling unit selections across all age groups to a maximum of two.

- Minimize the number of sample dwelling units that must be screened to achieve the targeted domain sample sizes.

- Eliminate all variation in the sample inclusion probabilities within a domain except for the variation in the within-dwelling unit/within-domain probabilities of selection. The inverse probabilities of selection for each sample segment were used to determine the number of sample lines to select from within each segment. As a consequence, all dwelling units within a specific stratum were selected with approximately the same probability, and therefore, approximately equalized dwelling unit sampling weights. This feature minimizes variance inflation that results from unnecessary variation in sampling weights.

- Equalize the expected number of sample persons per cluster to balance the interviewing workload and to facilitate the assignment of interviewers to regions and segments. This feature also minimizes adverse effects on precision resulting from extreme cluster size variations.

- Simplify the size measure data requirements so that decennial Census data (block level counts) are adequate to implement the method.

Using the 1990 Census data supplemented with revised population projections, a composite size measure was computed for each Census block defined within the United States. The composite size measure began by defining the rate $f_h(d)$ at which we wished to sample each age group domain d (d=1,...,5) from state h.

Let $C_{hijk}(d)$ be the population count from domain d in Census block k of segment j of FI region i within each state h. The composite size measure for block k was defined as:

$$S_{hij+} = \sum_{d=1}^{5} f_h(d) \sum_{j=1}^{N_{hij}} C_{hijk}(d). \quad (2)$$

The composite size measure for segment j was calculated as:

$$S_{hijk} = \sum_{d=1}^{5} f_h(d)\ C_{hijk}(d), \quad (3)$$

where N_{hij} equals the number of blocks within segment j of FI region i and state h.

2.2 Stratification

Because the 5-year NHSDA design provides for estimates by state in all 50 states plus the District of Columbia, states may be viewed as the first level of stratification. The objective of the next level of stratification was to distribute the number of interviews, in expectation, equally among FIs. Within each state, Census tracts were joined to form mutually exclusive and exhaustive FI regions of approximately equal sizes (aggregate composite size measures of roughly 100). Using desktop computer mapping software, the regions were formed taking into account geographical boundaries, such as mountain ranges and rivers, to the extent possible. Therefore, the resulting regions facilitated ease of access as well as distributing the workload evenly among NHSDA interviewers. Twelve FI regions were formed in each state, except in California, Florida, Illinois, Michigan, New York, Ohio, Pennsylvania, and Texas, where 48 regions were formed.[10]

To form segments within FI regions, adjacent Census blocks were collapsed until the total number of dwelling units within the area was at least 175 and the size measure was at least 9.38 times the maximum of F_1, F_2, F_3, F_4, and F_5, where F_i is the person sampling rate for age group i in the state. The number 9.38 is the desired number of responding persons in each segment. Latitude and longitude and sorting within block groups, tracts, and counties were used to obtain geographic ordering of the blocks. Segments were required to be entirely within FI region and county boundaries; however, they could span Census tracts and block groups. This crossing-over was avoided as much as possible. Table 2.1 summarizes the segment sampling frame by state.

[10]The design called for 300 persons in each of three age groups (12 to 17, 18 to 25, and 26 and older) equally allocated to four quarters within each small sample state. Based an analysis of the cost variance tradeoffs, an average cluster size of 3.125 persons in each of the three age groups (or an average of 9.375 persons over the three age groups combined) was considered near optimal. When applied to the small states, a quarterly sample of 75 persons per quarter per age group could be obtained from 24 clusters or area segments. For unbiased variance estimation purposes at least two observations are required per stratum; maximum geographic stratification was obtained by defining 12 strata with 2 area segments each per quarter. Two additional segments were selected for each of the other 3 quarters yielding 8 area segments per stratum or 96 area segments per small sample state. This stratum configuration also corresponded with reasonable average workload for a single field interviewer (FI) leading to us to designate the geographic strata within state as FI regions. This approach supported a target sample size for the small states of 300 persons per age group or a total of 900 for the year. In the large sample states, four times as large a sample was required. Optimum cluster size configuration and maximum stratification given the need for unbiased variance estimation were maintained by simply quadrupling the number of FI regions to 48 per large sample state yielding a sample 300 persons per age group per quarter, 1,200 per age group over four quarters, and 3,600 per year over the all three age groups.

Table 2.1 Number of Segments on Sampling Frame by State

State	State Abbreviation	State Fips Code	Number of Segments on Sampling Frame	Total Number of Segments Selected	Number Selected for Five-Year Sample	Unique Segments in Five-Year Sample
Total U.S.			499,287	86,400		
Northeast						
Connecticut	CT	09	5,978	1,152	288	288
Maine	ME	23	2,573	1,152	288	288
Massachusetts	MA	25	11,413	1,152	288	288
New Hampshire	NH	33	2,246	1,152	288	286
New Jersey	NJ	34	14,343	1,152	288	288
New York	NY	36	30,600	4,608	1,152	1,151
Pennsylvania	PA	42	24,256	4,608	1,152	1,151
Rhode Island	RI	44	1,912	1,152	288	282
Vermont	VT	50	1,248	1,152	288	284
North Central						
Illinois	IL	17	22,549	4,608	1,152	1,151
Indiana	IN	18	11,987	1,152	288	288
Iowa	IA	19	6,210	1,152	288	288
Kansas	KS	20	5,430	1,152	288	288
Michigan	MI	26	18,477	4,608	1,152	1,152
Minnesota	MN	27	9,364	1,152	288	288
Missouri	MO	29	10,871	1,152	288	288
Nebraska	NE	31	3,567	1,152	288	288
North Dakota	ND	38	1,330	1,152	288	286
Ohio	OH	39	21,500	4,608	1,152	1,151
South Dakota	SD	46	1,603	1,152	288	285
Wisconsin	WI	55	10,704	1,152	288	288
South						
Alabama	AL	01	8,702	1,152	288	288
Arkansas	AR	05	5,411	1,152	288	288
Delaware	DE	10	1,346	1,152	288	281
Washington, D.C.	DC	11	943	1,152	288	273
Florida	FL	12	26,545	4,608	1,152	1,152
Georgia	GA	13	13,398	1,152	288	288
Kentucky	KY	21	7,718	1,152	288	287
Louisiana	LA	22	8,216	1,152	288	288
Maryland	MD	24	8,340	1,152	288	288
Mississippi	MS	28	5,473	1,152	288	288
North Carolina	NC	37	14,955	1,152	288	288
Oklahoma	OK	40	6,941	1,152	288	288
South Carolina	SC	45	7,437	1,152	288	287
Tennessee	TN	47	10,764	1,152	288	288
Texas	TX	48	34,367	4,608	1,152	1,151
Virginia	VA	51	11,666	1,152	288	288
West Virginia	WV	54	3,757	1,152	288	288

(continued)

Table 2.1 Number of Segments on Sampling Frame by State (continued)

State	State Abbreviation	State Fips Code	Number of Segments on Sampling Frame	Number of Segments Selected	Number Selected for Five-Year Sample	Unique Segments in Five-Year Sample
West						
Alaska	AK	02	1,139	1,152	288	273
Arizona	AZ	04	8,212	1,152	288	288
California	CA	06	53,064	4,608	1,152	1,152
Colorado	CO	08	7,977	1,152	288	287
Hawaii	HI	15	1,658	1,152	288	276
Idaho	ID	16	2,611	1,152	288	288
Montana	MT	30	2,028	1,152	288	286
Nevada	NV	32	2,625	1,152	288	276
New Mexico	NM	35	3,369	1,152	288	288
Oregon	OR	41	6,835	1,152	288	288
Utah	UT	49	3,475	1,152	288	288
Washington	WA	53	11,086	1,152	288	287
Wyoming	WY	56	1,068	1,152	288	285

2.3 First-Stage Sample Selection

Once the segments were formed, a probability proportional to size sample of segments was selected with minimum replacement within each FI region. The sampling frame was implicitly stratified by sorting the first-stage sampling units by an MSA/SES (socioeconomic status) indicator[11] and by the percent of the population that is non-Hispanic and white. As Table 2.1 indicates, 96 segments per FI region were chosen for a total of 1,152 segments in each state, except in the large states where a total of 4,608 segments were chosen. Although only 24 segments were needed to support the 5-year study, an additional 72 segments were selected to serve as replacements when segment lines are depleted and/or to support any supplemental studies embedded within the NHSDA.

2.4 Survey Year and Quarter Assignment

Within each FI region, the 96 selected segments were assigned to a survey year and quarter in a random, systematic fashion. Because segments can be selected multiple times, the goal was to avoid putting the same segment in consecutive survey years. Therefore, survey years and quarters were assigned using a random starting point and the order defined in Table 2.2. The notation in the table is as follows:

99A = Segment for the 1999 NHSDA
99B = Segment for the 1999 NHSDA and used again in the 2000 NHSDA.
00 = Segment for the 2000 NHSDA and used again in the 2001 NHSDA.
01 = Segment for the 2001 NHSDA and used again in the 2002 NHSDA.
02 = Segment for the 2002 NHSDA and used again in the 2003 NHSDA.
03 = Segment for the 2003 NHSDA.

[11]Four categories are defined as: (1) MSA/low SES, (2) MSA/high SES, (3) Non-MSA/low SES, and (4) Non-MSA/high SES.

Table 2.2 Survey Year and Quarter Assignment Order for 96 Segments within Each FI Region

Order	Survey Year	Quarter	Variance Replicate
1	99A	1	1
2	Y00	1	15
3	X99B	1	8
4	Z01	1	22
5	02	1	5
6	Y99A	1	13
7	X03	1	12
8	Z99B	1	20
9	00	1	3
10	Y02	1	17
11	X01	1	10
12	Z03	1	24
13	01	1	4
14	Y03	1	18
15	X02	1	11
16	Z99A	1	19
17	99B	1	2
18	Y01	1	16
19	X00	1	9
20	Z02	1	23
21	03	1	6
22	Y99B	1	14
23	X99A	1	7
24	Z00	1	21

Order	Survey Year	Quarter	Variance Replicate
25	99A	2	1
26	Y00	2	15
27	X99B	2	8
28	Z01	2	22
29	02	2	5
30	Y99A	2	13
31	X03	2	12
32	Z99B	2	20
33	00	2	3
34	Y02	2	17
35	X01	2	10
36	Z03	2	24
37	01	2	4
38	Y03	2	18
39	X02	2	11
40	Z99A	2	19
41	99B	2	2
42	Y01	2	16
43	X00	2	9
44	Z02	2	23
45	03	2	6
46	Y99B	2	14
47	X99A	2	7
48	Z00	2	21

Order	Survey Year	Quarter	Variance Replicate
49	99A	3	1
50	Y00	3	15
51	X99B	3	8
52	Z01	3	22
53	02	3	5
54	Y99A	3	13
55	X03	3	12
56	Z99B	3	20
57	00	3	3
58	Y02	3	17
59	X01	3	10
60	Z03	3	24
61	01	3	4
62	Y03	3	18
63	X02	3	11
64	Z99A	3	19
65	99B	3	2

Order	Survey Year	Quarter	Variance Replicate
73	99A	4	1
74	Y00	4	15
75	X99B	4	8
76	Z01	4	22
77	02	4	5
78	Y99A	4	13
79	X03	4	12
80	Z99B	4	20
81	00	4	3
82	Y02	4	17
83	X01	4	10
84	Z03	4	24
85	01	4	4
86	Y03	4	18
87	X02	4	11
88	Z99A	4	19
89	99B	4	2

(continued)

Table 2.2. Survey Year and Quarter Assignment Order for 96 Segments within Each FI Region (continued)

Order	Survey Year	Quarter	Variance Replicate	Order	Survey Year	Quarter	Variance Replicate
66	Y01	3	16	90	Y01	4	16
67	X00	3	9	91	X00	4	9
68	Z02	3	23	92	Z02	4	23
69	03	3	6	93	03	4	6
70	Y99B	3	14	94	Y99B	4	14
71	X99A	3	7	95	X99A	4	7
72	Z00	3	21	96	Z00	4	21

X, Y, and Z denote extra segments for the corresponding NHSDA survey year. The 24 segments assigned to survey years not beginning with X, Y, and Z would then be used to field the 5-year study. Using the survey year and quarter assignments, a sequential segment identification number (SEGID) was then assigned. Table 2.3 describes the relationship between segment identification numbers and quarter assignment.

2.5 Creation of Variance Estimation Strata

The nature of the stratified clustered sampling design requires that the design structure be taken into consideration when computing variances of survey estimates. Key nesting variables were created to capture explicit stratification and to identify clustering. For the 1999-2003 NHSDAs, each FI region comprised its own stratum.

Two replicates per year were defined within each variance stratum. The first replicate consists of those segments that are "phasing out" or will not be used in the next survey year. The second replicate is made up of those segments that are "phasing in" or will be fielded again the following year, thus constituting the 50% overlap between survey years. Each variance replicate consists of four segments, one for each quarter of data collection. Table 2.2 describes the assignment of segments to variance estimation replicates.

All weighted statistical analyses for which variance estimates are needed should use the stratum and replicate variables to identify nesting. Variance estimates can be computed by using clustered data analysis software packages such as SUDAAN (Shah, 1997). The SUDAAN software package computes variance estimates for nonlinear statistics using procedures such as a first-order Taylor series approximation of the deviations of estimates from their expected values. The approximation is unbiased for sufficiently large samples.

Table 2.3. Segment Identification Number Suffixes[12] for the 1999-2003 NHSDAs

Segment Suffix	1999 NHSDA	2000 NHSDA	2001 NHSDA	2002 NHSDA	2003 NHSDA
01	x (Q1)				
02	x (Q1)	x (Q1)			
03	x (Q2)				
04	x (Q2)	x (Q2)			
05	x (Q3)				
06	x (Q3)	x (Q3)			
07	x (Q4)				
08	x (Q4)	x (Q4)			
09		x (Q1)	x (Q1)		
10		x (Q2)	x (Q2)		
11		x (Q3)	x (Q3)		
12		x (Q4)	x (Q4)		
13			x (Q1)	x (Q1)	
14			x (Q2)	x (Q2)	
15			x (Q3)	x (Q3)	
16			x (Q4)	x (Q4)	
17				x (Q1)	x (Q1)
18				x (Q2)	x (Q2)
19				x (Q3)	x (Q3)
20				x (Q4)	x (Q4)
21					x (Q1)
22					x (Q2)
23					x (Q3)
24					x (Q4)

[12]The segment suffix is defined as the last two digits of the segment identification number.

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Chapter 3: General Sample Allocation Procedures for the Main Study

In this chapter, the computational details of the procedural steps used to determine both person and dwelling unit sample sizes will be discussed; the within-dwelling unit age group specific selection probabilities for the 1999 NHSDA main study design are also addressed. This optimization procedure was specifically designed to address SAMHSA's multiple precision and design requirements while simultaneously minimizing the cost of data collection. Costs were minimized by determining the smallest number of interviews and selected dwelling units necessary to achieve the various design requirements. In summary, this three-step optimization procedure proceeded as follows:

1. At the first step, we determined the optimal number of interviews (i.e., responding persons) by domains of interest needed to satisfy the precision requirements for several drug outcome measures. In other words, we initially sought to determine 255 unknown m_{ha} for each state h (51) and age group a (5). A solution to this multiple constraint optimization was achieved utilizing Chromy's Algorithm (Chromy, 1987). This is described in further detail in Section 3.2.

2. Using the m_{ha} determined from step 1, the next step was to determine the optimal number of selected dwelling (D_{hj}) units (i.e., second-stage sample) necessary. This step was achieved by applying parameter constraints (e.g., probabilities of selection and expected response rates) at the segment level j or the stage at which dwelling units would be selected. This was done on a quarterly basis using 25% of the m_{ha}'s. This step is described in further detail in Section 3.3.

3. The final step in this procedure entails determining age group specific probabilities of selection (S_{hja}) for each segment given m_{ha} and D_{hj} from steps 1 and 2. This is achieved using a modification of Brewer's Method of Selection (Cochran, 1977, pp.261-263). The modification was designed to select 0, 1, or 2 persons from each dwelling unit.[13] A detailed discussion of the final step is given in Section 3.4. After calculation of the required dwelling units and the selection probabilities, sample size constraints[14] were applied to ensure adequate sample for overlapping designs and/or supplemental studies and to reduce field interviewer burden. Also limits on the total number of expected interviews per segment were applied. This process became iterative to reallocate the reduction in sample size to other segments not affected by such constraints. Details of this step in the optimization procedure are given in Section 3.5.

3.1 Notation

h = 50 U.S. States plus the District of Columbia.

a = Age group. a=1..5 and represents the following groups: 12 to 17 year olds, 18 to 25 year olds, 26 to 34 year olds, 35 to 49 year olds, and 50+ year olds.

[13]Direct application of Brewer's method would require a fixed sample size.

[14]Because of the overlap of the split sample, constraints were applied to the combination of both the main and supplemental required dwelling unit sample size. Specifically, some segments with both modes of interviewing would be revisited in the 2000 survey.

j = Individual segment indicator (total of 7,200; 1,800 per quarter).

s = Design parameter estimated strata. Utilized for estimating response and eligibility rates from historic NHSDA data and to compensate for changes in the study design. Individual segments are defined into 1 of the 6 strata. For the 1999 main study NHSDA, s=1..6 are defined as follows:

Stratum	Defining Criteria
1: High Hispanic	50% or more Hispanic population
2: High black*	50% or more black population
3: High minority	50% or more Hispanic + black population
4: High white**	90% or more white population
5: Medium white	75% up to 90% white population
6: Remainder	All remaining segments

* *Black refers to black, non-Hispanic.*
** *White for brevity refers to nonblack, non-Hispanic.*

m_{ha} = Number of completed interviews (person respondents) desired in each state h and age group a. Computation of m_{ha} is discussed in Section 3.2. For purposes of quarter computation of selected dwelling unit sample size, 25% of the yearly estimate is used.

y_{ha} = Estimated number of persons in the target population in state h and age group a. The 1999 population is estimated using the 1990 Census data and the 2001 Claritas Population Projections in the compound interest formula, $y = Ae^{Bx}$, where

y = population at time x,
A = initial population,
e = base of the system of natural logarithms,
B = growth rate per unit of time, and
x = period of time over which growth occurs.

First, B is computed as {ln(y/A)}/x, where y = the population in 2001, A = the population in 1990 and x = 11. Then, the 1999 population (y^*_{ha}) is computed using the original formula and this time allowing x to be 9. Finally, the 1999 population is adjusted by the ratio of estimated eligible listed dwelling units to the Claritas dwelling unit counts (U_{hj}). This adjustment factor considers the number of added dwelling units expected to be obtained through the half-open interval rule (1.00574) and the probability of a dwelling unit being eligible (ε_s), both determined via historic data. The coefficient adjustment of 1.00574 is calculated using 1997 NHSDA data as the proportion of all screened dwelling units (includes added) over the original total of selected dwelling units (excluding added dwelling units) So, $y_{ha} = [(1.00574 * \varepsilon_s * L_{hj} * (1/I_{hj})) / U_{hj}] * y^*_{ha}$, where ε_s, L_{hj}, and I_{hj} are defined further below. This adjustment is computed at the Census block level then aggregated to the state level.

f_{ha} = m_{ha} / y_{ha}. State-specific age group sampling fraction.

F_h = Max{f_{ha} a=1-5}.

P_{hj} = Inverse of the segment selection probability. Dwelling unit sample sizes are computed on a quarterly basis and segments are selected on a yearly basis. Since each quarter only contains a fourth of the

selected segments, these probabilities are adjusted by a factor of 4, so that weights will add to the yearly totals.

I_{hj} = Subsegmentation inflation factor. For segments too large to count and list efficiently in both time and cost, field listing personnel are allowed to subsegment the segment into roughly equal size subdivisions. They perform a quick count (best guess: L^*_{hj}) of the entire segment and then subdivide (taking also a best guess estimate of the number of dwelling units in each subsegment: B^*_{hj}). Using a selection algorithm provided by RTI , one subsegment is selected for regular counting and listing. For the subsegment to represent the entire segment, the weights are adjusted up to reflect the unused portion of the segment.

$=(B^*_{hj} / L^*_{hj})$
= 1, if no subsegmenting was done.

D_{hj} = Minimum number of dwelling units to select for screening in segment *j* to meet the targeted sample sizes for all age groups.

L_{hj} = Final segment count of dwelling units available for screening.

S_{hja} = State, segment-specific probability of selecting a person in age group *a.* A design constraint implemented is that no single age group selection probability could exceed 1. The maximum allowable probability was then set to .99.

S_{sa} = Stratum-specific probability of selecting a person in age group *a.* Only used in calculation of Max of 2 rule (δ_{sa}) described below. As with S_{hja}, the maximum allowable probability is .99.

ε_s = Stratum-specific, dwelling unit eligibility rate. Derived from 1997 NHSDA data using a logistic regression model by defining all 1997 segments into the 1999 stratum definitions. 1999 NHSDA segments defined within the same stratum received the same rate.

φ_s = Stratum-specific, screening response rates. Calculated using the same methodology as described for the dwelling unit eligibility rate (ε_s).

λ_{sa} = Stratum and age group-specific interview response rate. Using data from the 1997 NHSDA, the additive effects of stratum and age group on interviewer response were determined using a constrained, weighted logistic model.

γ_{sa} = Expected number of persons within an age group per dwelling unit. Calculated using 1997 NHSDA data by dividing the weighted total number of rostered persons in an age group by the weighted total number of complete screened dwelling units for each stratum.

δ_{sa} = Stratum and age group-specific maximum-of-two rule adjustment. The survey design restricts the number of interviews per dwelling unit to a total of two. This is achieved through a modified Brewer's method of selection. This results in a loss of potential interviews in dwelling units where selection probabilities sum greater than two. The adjustment is designed to inflate the number of required dwelling units to compensate for this loss. This procedure is iterative and utilizes 1997 NHSDA data as described below. (Note that, since prior NHSDA data are unavailable for each segment, maximum-of-two rule adjustments are computed at the stratum level.)

1. Determine the number of required dwelling units (R_{sa}) necessary to obtain desired person sample sizes under the assumption that age group sample sizes are the same across the strata (use overall national sample sizes).

$$R_{sa} = \frac{m_a}{(\varepsilon_s * \varphi_s * \lambda_{sa} * \gamma_{sa} * \delta_{sa})} \quad where \; m_a = \sum_h m_{ha}, \quad \delta_{sa} = 1 \; for \; first \; iteration \tag{4}$$

2. Set S_{sa} = .99 for the age group with the largest R_{sa}. All other age group probabilities are set in proportion to the largest:

$$S_{sa} = \frac{R_{sa}}{Max(R_{sa})} \tag{5}$$

3. Assign S_{sa} to respective person record in 1997 NHSDA data. With the modified Brewer's method, selection probabilities are now adjusted to reflect the total household composition. In short, if selection probabilities for all eligible dwelling unit members sum greater than two, then probabilities are ratio adjusted to sum to two. This will be denoted as S^*_{sa}. However, sums less than two are unadjusted.

4. Sum S_{sa} and S^*_{sa} within stratum. The maximum-of-two rule (δ_{sa}) is then calculated as the ratio of the summed S^*_{sa} / S_{sa}.

5. Insert new calculated δ_{sa} into step 1 and repeat steps 1 through 5. Continue until the absolute difference between δ_{sa} of the current cycle and the previous cycle is less than .001, usually about three to four iterations.

3.2 Determining Person Sample Sizes by State and Age Group

The first step in the design of the third stage of selection was to determine the optimal number of respondents for each of the 255 domains that would be needed to minimize costs associated with data collection, subject to multiple precision requirements established by SAMHSA. In summary, these precision requirements on the relative standard error (RSE) of an estimate of 10% for SAMHSA's 17 subpopulations of interest are:

- RSE = 3.40% for the total, national population.
- RSE = 5.00% for the national population in each of the four age groups: 12 to 17 year olds, 18 to 25 year olds, 26 to 34 year olds, 35+ year olds.
- RSE = 5.00% for the population within each of the four age groups for white (i.e., nonblack, non-Hispanic).
- RSE = 11.00% for the population within each of the four age groups for blacks (i.e., black, non-Hispanic).
- RSE = 11.00% for the population within each of the four age groups for Hispanics.

Note, one stratification feature that we used in previous NHSDA designs and was worth including in the design of the current NHSDA is the expansion of the age group domain to 12 to 17, 18 to 25, 26 to 34 , 35 to 49, and 50+ year olds. This age group stratification parallels SAMHSA's NHSDA subpopulation of interest, as implied by the precision constraints, except for the age group 35 and older. As we have done with the NHSDA designs since 1992, we have chosen to further stratify this important age group by 35 to 49 and 50+ year olds to decrease the total number of 35+ year olds needed to meet precision requirements. Since substance abuse is more prevalent among the 35 to 49 year olds compared to the 50+ year olds, oversampling this younger age group will increase the precision of the estimates generated for the 35+ year olds, while minimizing the total number of 35+ year olds needed in the sample.

To form precision constraints that reflect the above standard error requirements, we have set up a preliminary Step-1 Optimization using (1) design effects estimated from the 1994-1996 NHSDA data, (2) population counts obtained from Claritas, Inc., and (3) various outcome measures that were estimated for each block group in the United States from our recently completed 1991-1993 NHSDA small area estimation (SAE) project. Appropriate variance constraints were defined for nine outcome measures of interest. These outcome measures of interest were included to address not only the NHSDA recency-of-use estimates but also such related generic substance abuse measures as treatment received for alcohol and illicit drug use and dependency on alcohol and illicit drug use.

Specifically, the nine classes of NHSDA outcomes we considered are:

Use of Legal (Licit) Substances

1. *Cigarette Use in the Past Month.* Smoked cigarettes at least once within past month.

2. *Alcohol Use in the Past Month.* Had at least one drink of an alcoholic beverage (beer, wine, liquor, or a mixed alcohol drink) within the past month.

Use of Illicit Substances

3. *Any Illicit Drug Use in the Past Month.* Includes hallucinogens, heroin, marijuana, cocaine, inhalants, opiates or nonmedical use of sedatives, tranquilizers, stimulants or analgesics.

4. *Any Illicit Drug Use Other than Marijuana in the Past Month.* Past month use of any illicit drug excluding those whose only illicit drug use was marijuana.

5. *Cocaine Use in the Past Month.* Use within the past month of cocaine in any form, including crack.

Note that current use of any illicit drug provides a broad measure of illicit drug use; however, it is dominated by marijuana and cocaine use. Therefore, estimates of marijuana and cocaine are included since these two measures reflect different types of drug abuse.

Drug or Alcohol Dependence

6. *Dependent on Illicit Drugs in the Past Year.* Dependent on the same drugs listed in *3. Any Illicit Drug Use in the Past Month* above. Those who are dependent on both alcohol and another illicit substance are included, but those who are dependent on alcohol only are not.

7. *Dependent on Alcohol and Not Illicit Drugs in the Past Year.* Dependent on alcohol and not dependent on any illicit drug.

Treatment for Drugs and Alcohol Problems

8. *Received Treatment for Illicit in the Past Year.* Received treatment in the past 12 months at any location (including hospitals, clinics, self-help groups, doctors) for any illicit drugs.

9. *Received Treatment for Alcohol Use but Not Illicit Drugs in the Past Year.* Received treatment in the past 12 months for drinking (including hospitals, clinics, self-help groups, doctors). These estimates exclude those who received treatment in the past 12 months for both drinking and illicit drugs.

These outcome measures considered, as well as the precision that is expected from this 1999 NHSDA design are presented in Table 3.1.

Additionally, initial sample size requirements were implemented:

- Minimum sample size of 3,600 persons per state in the eight large states and 900 persons in the remaining 43 states.

- Equal allocation of the sample across the three age groups: 12 to 17, 18 to 25, and 26+ within each state.

A tobacco brand interview supplement and an additional sample of 2,500 youths aged 12 to 17 were added to the NHSDA to allow for estimation of tobacco brand usage by youth. The 2,500 additional youth were allocated to states in the following manner.

1. Calculate the expected 12 to 17 sample for each state based on population.[15]

$$m^{Pop}_{h(12\text{-}17)} = (22{,}500 - (1.85 * 2{,}500)) * (N_{h(12\text{-}17)} / N_{(12\text{-}17)}) \quad (6)$$

2. Find difference between original sample allocation ($m_{h(12\text{-}17)}$) and allocation based on population ($m^{Pop}_{h(12\text{-}17)}$).

$$diff = m_{h(12\text{-}17)} - m^{Pop}_{h(12\text{-}17)} \quad (7)$$

   - If *diff* is negative, the original sample requires over-sampling and for cost purposes no additional 12 to 17 sample is allocated to these states.

   - If *diff* is positive, no oversampling of the 12 to 17 is necessary for the original sample allocation. The additional 2,500 sample is allocated to these states as the value of *diff*.

Furthermore, race/ethnicity groups are not oversampled for the 1999 main study. However, consistent with previous NHSDAs, 1999 NHSDA is designed to over-sample the younger age groups.

[15]Sample size determination based on population alone would have required a reduction of the originally allocated sample in some states. Since this was not feasible for state-level precision and estimates purposes, a reduction in total sample size was necessary to compensate for not reducing the sample below the original sample size. 1.85 was iteratively computed as the value necessary for correct sample allocation calculation.

Table 3.1 Expected Relative Standard Errors By Race/Ethnicity and Age Group: Main Sample

	Total Respondents					Hispanic Respondents				
Outcome Measure	**12-17**	**18-25**	**26-34**	**35+**	**Total**	**12-17**	**18-25**	**26-34**	**35+**	**Total**
Expected Relative Standard Error for Classes of Outcome Measures										
Past Year, Dependence on Alcohol (not Illicit Drugs)	2.49	2.70	4.29	3.56	2.27	6.16	7.54	10.72	11.65	6.04
Past Month Alcohol Use	2.57	2.71	4.23	3.58	2.47	6.42	7.47	10.62	11.40	6.42
Past Month Cigarette Use	2.31	2.62	4.13	3.30	2.22	6.92	7.11	10.31	11.99	6.90
Past Month Cocaine Use	2.29	2.50	3.57	2.30	1.55	6.32	7.42	10.21	9.95	5.18
Past Year Received Treatment For Illicit Drug Use	2.44	2.57	3.58	2.97	1.87	6.53	7.17	10.44	10.72	5.65
Past Year Received Treatment For Alcohol Use	2.43	2.51	3.52	3.05	2.02	6.47	7.24	10.04	10.67	5.82
Past Month Use of Any Illicit Drug But Marijuana	2.31	2.49	3.60	3.03	1.82	6.43	7.57	10.40	11.08	5.14
Dependence on Illicit Drugs	2.43	2.63	3.61	2.93	1.77	6.49	7.42	10.43	10.61	4.93
Past Month Illicit Drug Use	2.44	2.57	3.60	3.15	1.80	6.49	7.13	10.31	10.94	5.19
Average Relative Standard Error	2.41	2.59	3.79	3.10	1.98	6.47	7.34	10.39	11.00	5.69
Target Relative Standard Error	5.00	5.00	5.00	5.00	3.40	11.00	11.00	11.00	11.00	

	Black Respondents					White Respondents				
Outcome Measure	**12-17**	**18-25**	**26-34**	**35+**	**Total**	**12-17**	**18-25**	**26-34**	**35+**	**Total**
Expected Relative Standard Error for Classes of Outcome Measures										
Past Year, Dependence on Alcohol (not Illicit Drugs)	6.40	7.14	10.13	10.14	6.28	2.79	3.10	4.33	3.70	2.51
Past Month Alcohol Use	6.65	7.19	10.03	10.28	6.23	2.88	3.11	4.33	3.73	2.78
Past Month Cigarette Use	6.29	7.31	10.17	10.11	6.42	2.70	3.02	4.50	3.61	2.48
Past Month Cocaine Use	6.36	6.48	9.23	8.87	5.55	2.75	2.85	4.15	2.62	1.64
Past Year Received Treatment For Illicit Drug Use	6.08	6.98	10.23	9.15	5.77	2.82	3.07	4.14	3.22	2.05
Past Year Received Treatment For Alcohol Use	6.09	6.52	10.18	9.43	6.11	2.79	3.00	4.08	3.21	2.26
Past Month Use of Any Illicit Drug But Marijuana	6.33	6.84	9.96	9.31	5.24	2.68	2.87	4.18	3.35	1.96
Dependence on Illicit Drugs	6.12	7.01	10.14	9.38	5.78	2.78	3.15	4.24	3.14	1.96
Past Month Illicit Drug Use	6.10	6.85	10.15	9.56	5.26	2.78	3.07	4.20	3.35	2.00
Average Relative Standard Error	6.27	6.92	10.02	9.58	5.85	2.78	3.03	4.24	3.33	2.18
Target Relative Standard Error	11.00	11.00	11.00	11.00		5.00	5.00	5.00	5.00	

Among the 51 states, a required total sample size of 70,000 respondents is necessary to meet all precision and sample size requirements. Table 3.2 displays the final state by age group sample size distribution which was equally allocated to each of the four quarters.

3.3 Second-Stage Sample Allocation for Each Segment

Given the desired respondent sample size for each state and age group (m_{ha}) needed to meet the design parameters established by SAMHSA, the next step is to determine the minimal number of dwelling units to select for each segment to meet the targeted sample sizes. In short, this step involves determining the sample size of the second-stage of selection. This sample size determination is performed on a quarterly basis to take advantage of both segment differences and if necessary make adjustments to design parameters. Procedures described below were originally developed for initial implementation in quarter 1 of the survey. The description below is specific to quarter 1. Any modifications/corrections were made in subsequent quarters and are explained in detail in Section 3.7.

3.3.1 Dwelling Unit Frame Construction – Counting and Listing

The process by which the dwelling unit frame is constructed is called counting and listing. In summary, a certified lister visits the selected area and lists a detailed and accurate address (or description if no address is available) for each dwelling unit within the segment boundaries. The lister is given a series of maps on which he or she also makes note of the location of these dwelling units. The resulting list of dwelling units is entered into a database and serves as the frame from which the second-stage sample is drawn.

In some situations, the number of dwelling units within the segment boundaries is much larger than the specified maximum. To obtain a reasonable number of dwelling units for the frame, the lister will first count the dwelling units in such an area. The sampling staff at RTI will then partition the segment into smaller pieces or subsegments and randomly select one to be listed. For more information on the subsegmenting procedures, see the Counting and Listing Supplement for Subsegmenting (RTI, 1996).

During counting and listing, the lister moves about the segment in a prescribed fashion called the "continuous path of travel." In short, the lister attempts to move in a clockwise fashion, makes each possible right turn, makes U-turns at segment boundaries, and doesn't break street sections. Following these defined rules and always looking for dwelling units on the right hand side of the street, the lister minimizes the chance of not listing a dwelling unit within the segment. Also, using a defined path of travel makes it easier for the FI assigned to the segment to locate the sampled dwelling units. Finally, the continuous path of travel lays the groundwork for the half-open interval procedure for recovering missed dwelling units as is described in Section 3.7 of this report. A detailed description of the counting and listing procedures is provided in the 1999 NHSDA: Counting and Listing General Manual (RTI, 1999).

3.3.2 Determining Dwelling Unit Sample Size

For the main study, the optimization formula is as follows:

$$f_{ha} = P_{hj} * I_{hj} * \left(\frac{D_{hj}}{L_{hj}}\right) * S_{hja} * \varphi_s * \lambda_{sa} * \delta_{sa} \tag{8}$$

At this point in the procedure, only two components in the formula are unknown: D_{hj} and S_{hja}. Selection probabilities are segment- and age-group specific, and to maximize the number of selected persons

Table 3.2 Main Study Sample Sizes by State and Age Group

State	State FIPS	FI Regions	Total Segments	Total Respondents					
				12-17	18-25	26-34	35-49	50+	Total
Total Population		900	7,200	25,000	22,500	9,352	6,900	6,248	70,000
Northeast									
Connecticut	09	12	96	300	300	130	90	80	900
Maine	23	12	96	300	300	78	95	127	900
Massachusetts	25	12	96	350	300	139	87	74	950
New Hampshire	33	12	96	300	300	81	100	119	900
New Jersey	34	12	96	472	300	135	91	74	1,072
New York	36	48	384	1,200	1,200	572	350	278	3,600
Pennsylvania	42	48	384	1,200	1,200	556	341	303	3,600
Rhode Island	44	12	96	300	300	79	95	126	900
Vermont	09	12	96	300	300	79	99	122	900
North Central									
Illinois	17	48	384	1,200	1,200	571	376	253	3,600
Indiana	18	12	96	415	300	128	94	78	1,015
Iowa	19	12	96	300	300	120	95	86	900
Kansas	20	12	96	300	300	124	93	83	900
Michigan	26	48	384	1,200	1,200	532	372	296	3,600
Minnesota	27	12	96	319	300	127	94	80	919
Missouri	29	12	96	358	300	133	90	77	958
Nebraska	31	12	96	300	300	80	93	127	900
North Dakota	38	12	96	300	300	80	94	126	900
Ohio	39	48	384	1,200	1,200	508	381	311	3,600
South Dakota	46	12	96	300	300	80	92	128	900
Wisconsin	55	12	96	356	300	131	91	78	956
South									
Alabama	01	12	96	301	300	145	84	70	901
Arkansas	05	12	96	300	300	79	87	134	900
Delaware	10	12	96	300	300	82	96	123	900
District of Columbia	11	12	96	300	300	87	98	115	900
Florida	12	48	384	1,200	1,200	535	353	312	3,600
Georgia	13	12	96	522	300	145	91	65	1,122
Kentucky	21	12	96	300	300	136	87	77	900
Louisiana	22	12	96	315	300	142	89	69	915
Maryland	24	12	96	317	300	146	89	65	917
Mississippi	28	12	96	300	300	147	84	69	900
North Carolina	37	12	96	464	300	142	89	70	1,064
Oklahoma	40	12	96	300	300	140	85	75	900
South Carolina	45	12	96	300	300	141	89	70	900
Tennessee	47	12	96	360	300	138	89	73	960
Texas	48	48	384	1,484	1,200	629	348	223	3,884
Virginia	51	12	96	428	300	141	92	67	1,028
West Virginia	54	12	96	300	300	76	88	136	900

(continued)

Table 3.2 Main Study Sample Sizes by State and Age Group (continued)

State	State FIPS	FI Regions	Total Segments	Total Respondents					
				12-17	18-25	26-34	35-49	50+	Total
West									
Alaska	02	12	96	300	300	89	117	94	900
Arizona	04	12	96	319	300	145	89	66	919
California	06	48	384	2,231	1,200	599	383	218	4,631
Colorado	08	12	96	300	300	139	96	65	900
Hawaii	15	12	96	300	300	83	95	122	900
Idaho	16	12	96	300	300	80	97	123	900
Montana	30	12	96	300	300	77	95	128	900
Nevada	32	12	96	300	300	83	101	116	900
New Mexico	35	12	96	300	300	85	102	113	900
Oregon	41	12	96	300	300	144	85	71	900
Utah	49	12	96	300	300	85	105	110	900
Washington	53	12	96	389	300	154	82	64	989
Wyoming	56	12	96	300	300	80	101	119	900

within a dwelling unit, the age group whose sampling fraction (f_{ha}) = F_h , known now as the driving age group, is set to the largest allowable selection probability (S_{hja}) of .99. D_{hj} is then computed as:

$$D_{hj} = \frac{f_{ha}}{(P_{hj} * I_{hj} * S_{hja} * \varphi_s * \lambda_{sa} * \delta_{sa})} * L_{hj} . \quad (9)$$

3.4 Determining Third-Stage Sample (Person) Selection Probabilities for Each Segment

$$S_{hja} = \frac{f_{ha}}{P_{hj} * I_{hj} * (\frac{D_{hj}}{L_{hj}}) * \varphi_s * \lambda_{sa} * \delta_{sa}} \quad (10)$$

Having solved for D_{hj}, solve the selection probabilities for the remaining age groups. If the resulting probability is greater than .99, truncate the value to .99. If L_{hj} equals 0 and subsequently D_{hj} equals 0, then all S_{hja} equals 0.

3.5 Sample Size Constraints: Guaranteeing Sufficient Sample for Additional Studies and Reducing Field Interviewer Burden

A major area of interest for the survey is to ensure that an adequate sample of eligible dwelling units remain within each segments. This sample surplus is needed to provide for the yearly 50% overlap across segments, as well as to allow SAMHSA to implement supplemental studies. An adequate remaining sample has two advantages: (1) for the 50% overlap design, this will provide better precision in year-to-year trend estimates because of the expected positive correlation between successive NHSDA years and (2) it will reduce the amount of counting and listing costs.

In addition, concern was noted about guaranteeing that FIs would be able to complete the amount of work assigned to them within the quarterly time frame. These concerns prompted adjustments to the D_{hj} sample size:

1. Number of selected dwelling units for screening:< 100 or < ½*$L_{hj.}$ Adjustments were made by adjusting the D_{hj} counts to equal the minimum of 100 or ½*L_{hj} .

2. Expected number of interviews: < 40. Of special note, since some segments also contained the PAPI supplemental sample, this constraint applied to the combined/total number of interviews within the segment.

This expected number of interviews ($m^*_{hja(\text{main})}$) was computed for the main study as follows:

$$m^*_{hja(\text{main})} = D^*_{hj} * \varepsilon_s * \varphi_s * \gamma_{sa} * S_{hja} * \lambda_{sa} * \delta_{\text{sa}} \tag{11}$$

where D^*_{hj} has been adjusted for constraint 1. This value plus the $m^*_{hja(\text{supp})}$ computed for the supplemental PAPI is the total number of interviews expected within each segment. The calculation of the adjustment is:

$$40 / (m^*_{hja(\text{main})} + m^*_{hja(\text{supp})}) \tag{12}$$

This adjustment is applied to D_{hj} under the assumption of an equal number of screened dwelling units for each completed interview.

Both constraints 1 and 2 reduce the second-stage sample. This in turn could potentially reduce the expected third-stage sample size. Therefore, the reduction in second-stage sample is reallocated back to the segments by applying a marginal adjustment to the third-stage sample size (m_{ha}) at the state and age group level. As a result, segments that were not subject to these constraints could be affected. This adjustment to reallocate the dwelling unit sample was iterative until the expected person sample sizes were met.

Notes:

1. Quarter 1 reduction in D_{hj} did not reduce the expected number of interviews below that of the desired number of interviews. Hence, there was no marginal adjustment of the quarter 1 main study sample.

2. The optimization procedures implemented for the derivation of D_{hj} assign the larger dwelling unit samples to segments with better response rates. Often such segments are the first to be affected by the sample size constraints. Hence, when forced to reallocate the reduction in dwelling unit sample size to segments with poorer response rates, the overall dwelling unit sample size will increase in nonlinear amounts. In short, segments with worse response rates require more screened dwelling units per completed interview.

3.6 Dwelling Unit Selection and Release Partitioning

After derivation of the required dwelling unit sample size (D_{hj}), the sample is selected from the frame of counted and listed dwelling units for each segment (L_{hj}). The frame is ordered in the same manner as described in Section 3.3.1 and selection is completed using systematic sampling with a random start value.

Because of complications in quarter 1 (e.g., insufficient FI staff, reduced quarter time frame due to training and greater than expected PAPI workload (see Section 4.7)), a decision to reduce the sample size was made. This decision was made to minimize the effect on response rates, since released dwelling units

that are unworked are classified as nonrespondents and to further reduce FI burden by establishing a workload goal that was obtainable within the remaining quarter 1 time frame. Details on the mechanics of quarter 1 subsampling can be found in Appendix B.

Problems with the implementation of an interquarter subsampling, along with the effects of unequal weighting associated with subsampling, prompted a sample partitioning procedure to be implemented starting in quarter 2. The entire sample (D_{hj}) would still be selected, but only certain percentages of the total would be released into the field. An initial percentage would be released to all segments at the beginning of the quarter and based on interquarter work projections, additional percentages would be released if it was concluded that field staff could handle the added workload. Each partitioning of the sample is a valid sample and helps to control the amount of nonresponse without jeopardizing the validity of the study. Incidentally, in some quarters, a reserve sample was also selected, over and above the required D_{hj} sample, to try and compensate for any shortcomings in previous quarters. A summary of the quarterly samle sizes and percents released is provided in Table 3.3.

3.7 Half-Open Interval Rule and Procedure for Adding Dwelling Units

To guarantee that every dwelling unit has a chance of selection and to eliminate any bias associated with incomplete frames, the NHSDA implements a procedure called the half-open interval rule. This procedure requires that the interviewer look both on the property of each selected dwelling unit and between that dwelling unit and the next listed dwelling unit for any unlisted units. When found in these specific locations, the unlisted units become part of the sample (added dwelling units). If the number of added dwelling units linked to any particular sample dwelling unit did not exceed three or if the number for the entire segment was less than or equal to six, the FI was instructed to consider these dwelling units as part of their assignment. If either of these limits was exceeded, special subsampling procedures were implemented, as described in Appendix C.

3.8 Quarter-by-Quarter Deviations

The following section describes corrections and/or modifications that were implemented in the process of design optimization. *Design* refers to deviations from the original proposed plan of design. *Procedural* refers to changes made in the calculation methodologies. Even though *Constraints* could be included under both *Design* and *Procedural*, it was felt that they were important enough to addressed separately. Finally, *Dwelling Unit Selection* will address changes that occurred after sample size derivations. Specifically, corrections implemented during fielding of the sample (i.e., sample partitioning as described in Section 3.6). Quarter 1 deviations are not included since the methods and procedures described above were all implemented in quarter 1. Subsequently, any changes would have been made after quarter 1.

Note that no changes from the quarter 1 dwelling unit selection process were implemented in subsequent quarters. Hence, this section will only include changes in release partitioning and subsampling.

Quarter 2

Design: No changes

Procedural: No changes

Constraints: Marginal adjustments implemented (see Section 3.5)

Table 3.3 Quarterly Sample Sizes and Percent Released

State	Quarter 1			Quarter 2		
	# Selected	# Released	%	# Selected	# Released	%
Total	52,894	51,038	97	52,421	41,518	79
Northeast						
Connecticut	650	609	94	636	437	69
Maine	978	951	97	667	561	84
Massachusetts	842	820	97	736	497	68
New Hampshire	813	780	96	660	415	63
New Jersey	1,107	1,070	97	965	674	70
New York	2,590	2,491	96	2,453	1,846	75
Pennsylvania	2,587	2,491	96	2,560	1,893	74
Rhode Island	739	700	95	628	448	71
Vermont	639	619	97	671	462	69
North Central						
Illinois	2,301	2,217	96	2,510	1,939	77
Indiana	985	954	97	904	588	65
Iowa	592	573	97	655	606	93
Kansas	690	672	97	654	438	67
Michigan	2,339	2,230	95	2,546	1,934	76
Minnesota	628	603	96	684	470	69
Missouri	752	726	97	774	511	66
Nebraska	526	506	96	652	423	65
North Dakota	741	722	97	663	663	100
Ohio	2,337	2,219	95	2,595	1,969	76
South Dakota	681	664	98	657	657	100
Wisconsin	870	860	99	762	570	75
South						
Alabama	588	574	98	632	632	100
Arkansas	682	659	97	650	650	100
Delaware	685	654	95	636	414	65
District of Columbia	1,035	1,016	98	576	531	92
Florida	3,009	2,903	96	2,483	2,106	85
Georgia	861	840	98	1,101	836	76
Kentucky	555	524	94	656	475	72
Louisiana	650	626	96	667	667	100
Maryland	688	659	96	650	398	61
Mississippi	532	522	98	636	636	100
North Carolina	1,165	1,129	97	967	736	76
Oklahoma	663	643	97	657	420	64
South Carolina	509	481	94	642	642	100
Tennessee	646	613	95	783	588	75
Texas	2,705	2,603	96	2,777	2,777	100
Virginia	864	832	96	922	759	82
West Virginia	567	545	96	660	502	76

(continued)

Table 3.3 Quarterly Sample Sizes and Percent Released (continued)

State	Quarter 1			Quarter 2		
	# Selected	# Released	%	# Selected	# Released	%
West						
Alaska	604	588	97	663	663	100
Arizona	659	639	97	647	647	100
California	4,047	3,915	97	4,350	3,015	69
Colorado	771	732	95	615	477	78
Hawaii	670	651	97	660	660	100
Idaho	691	665	96	656	593	90
Montana	619	604	98	672	630	94
Nevada	716	695	97	671	463	69
New Mexico	586	571	97	520	476	92
Oregon	733	712	97	653	420	64
Utah	498	491	99	674	472	70
Washington	872	844	97	855	574	67
Wyoming	637	631	99	658	658	100

State	Quarter 3			Quarter 4		
	# Selected	# Released	%	# Selected	# Released	%
Total Population	75,713	68,483	90	66,155	60,887	92
Northeast						
Connecticut	1,014	842	83	1,087	1,076	99
Maine	933	933	100	812	740	91
Massachusetts	1,225	1,018	83	1,335	1,333	100
New Hampshire	1,027	995	97	892	845	95
New Jersey	1,569	1,305	83	1,670	1,418	85
New York	3,486	2,905	83	3,722	3,536	95
Pennsylvania	3,955	3,824	97	3,286	2,987	91
Rhode Island	1,051	889	85	937	937	100
Vermont	979	948	97	724	657	91
North Central						
Illinois	3,930	3,406	87	3,147	2,929	93
Indiana	1,299	1,084	83	1,189	1,082	91
Iowa	926	771	83	916	829	91
Kansas	911	818	90	760	693	91
Michigan	3,672	3,331	91	3,460	3,369	97
Minnesota	1,084	920	85	839	761	91
Missouri	1,174	1,007	86	1,081	983	91
Nebraska	963	842	87	797	772	97
North Dakota	799	799	100	552	504	91
Ohio	3,988	3,046	76	3,775	3,185	84
South Dakota	832	832	100	553	503	91
Wisconsin	1,161	964	83	1,081	982	91

(continued)

Table 3.3 Quarterly Sample Sizes and Percent Released (continued)

State	Quarter 3			Quarter 4		
	# Selected	# Released	%	# Selected	# Released	%
South						
Alabama	878	877	100	546	517	95
Arkansas	873	873	100	695	628	90
Delaware	1,075	1,075	100	849	771	91
District of Columbia	769	756	98	682	680	100
Florida	3,383	3,257	96	3,346	3,232	97
Georgia	1,635	1,585	97	1,232	1,119	91
Kentucky	879	879	100	537	487	91
Louisiana	865	763	88	683	621	91
Maryland	1,097	1,095	100	900	818	91
Mississippi	741	741	100	510	468	92
North Carolina	1,424	1,305	92	1,233	1,117	91
Oklahoma	1,002	865	86	883	804	91
South Carolina	881	732	83	912	826	91
Tennessee	1,212	1,007	83	988	839	85
Texas	3,579	3,040	85	3,071	2,785	91
Virginia	1,368	1,368	100	1,155	1,049	91
West Virginia	993	993	100	712	650	91
West						
Alaska	861	774	90	692	631	91
Arizona	771	771	100	596	565	95
California	6,184	5,594	90	5,689	5,179	91
Colorado	961	798	83	1,004	914	91
Hawaii	815	795	98	723	655	91
Idaho	850	708	83	716	656	92
Montana	844	756	90	708	643	91
Nevada	981	970	99	885	846	96
New Mexico	762	698	92	540	490	91
Oregon	1,039	1,020	98	817	742	91
Utah	902	881	98	547	497	91
Washington	1,288	1,274	99	993	901	91
Wyoming	823	754	92	696	636	91

Dwelling Unit Selection: No interquarter subsampling. Quarter 2 D_{hj} sample is allocated out to field supervisors (FSs) in the following release percentages:

Release 1: 50% of entire sample (100% of sample in even-numbered segments)
Release 2: 1/6 of entire sample (1/3 of sample in odd-numbered segments)
Release 3: 1/6 of entire sample (1/3 of sample in odd-numbered segments)
Release 4: 1/12 of entire sample (1/6 of sample in odd-numbered segments)
Release 5: 1/12 of entire sample (1/6 of sample in odd-numbered segments).

Additionally, the subsampled dwelling units from Quarter 1, classified as pending screeners, are revisited in quarter 2 to help increase the overall sample and reduce unequal weighting effects.

Quarter 3

Design: Sample size adjustment (20% increase to try and make-up what was lost in quarters 1 and 2, plus an additional 20% for reserve). Total adjustment of 1.44 % increase in age group sample size for each state. Resulted in an increase from 17,500 to 25,357. (See Appendix B).

Procedural:

1. As described in Section 3.3 it was observed that the age group with F_h did not always have the largest selection probability, S_{hja} (i.e., truncation rule for values greater then .99). This was due to fluctuations in the values of the interview response, λ_{sa} , and the maximum-of-two rule adjustment, δ_{sa} , across the age groups. These values were originally applied after the computation of F_h. Thus, to compensate for this, the formula used was $F_h = \max (f_{ha} / (\varphi_s * \lambda_{sa} * \delta_{sa}))$, which included the screener response rate, even though this does not fluctuate across age groups.

2. The type of problem described in "1." was also noted in the calculation of δ_{sa}. Fluctuations again in δ_{sa} and λ_{sa}, as well as, γ_{sa} sometimes caused differences between the "driving " age group in determining D_{hj} versus determining δ_{sa}. However, it was concluded that this produced only a marginal effect and no modifications were implemented.

3. When calculating S_{hja}, a rounded value of D_{hj} had been used. This rounding resulted in the possibility of S_{hja} being greater than .99 or less than .99 for the "driving"age group. It was therefore corrected to use the unrounded value of D_{hj} when calculating S_{hja}.

Constraints: Same as those implemented in quarter 2 plus the requirement that any segment with at least 10 listed dwelling units would have a minimum of five selected dwelling units to be screened (for cost purposes).

Dwelling Unit Selection: As implemented in quarter 2, the D_{hj} sample is allocated out in the following release percentages:

Release 1: 50% of main sample (which includes an additional 20%)
Release 2: 25% of main sample (which includes an additional 20%)
Release 3: 25% of main sample (which includes an additional 20%)
Release 4: 50% of reserve sample (20% of main sample)
Release 5: 50% of reserve sample (20% of main sample).

See design for quarter 3 above for further explanation. Unlike quarter 2, the release percentages are now applied at the state level.

Quarter 4

Design: Sample Size Adjustments. Three states (Illinois, Michigan and New York) had new sample sizes directly imposed: 1,050, 1,000, and 1,250 respectively. Other states were adjusted either up or down depending on each states' projected number of completed interviews. This adjustment was implemented to either (1) increase the shortcomings from earlier quarters or (2) reduce the workload on FIs in states that were expected to meet their yearly goals. Note that a bound of .75 in reduction was implemented. The reduction in workload also allowed FIs to be relocated to states that required an increase in their desired sample. After the adjustment was applied, an additional 10% was also selected to help correct any overall national short-comings. (See Appendix B.)

Procedural: Proceeded with the same changes as implemented in quarter 3.

Constraints: Proceeded with same changes as implemented in both quarters 2 and 3.

Dwelling Unit Selection: Same procedures as occurred in Quarter 3 with the following release percentages:

Release 1: 75% of main sample (original design allocation plus adjustment)
Release 2: 25% of main sample (original design allocation plus adjustment)
Release 3: 100% of reserve sample (10% of main sample).

See design for quarter 4 for further explanation.

3.9 Sample Weighting Procedures

At the conclusion of data collection for the last quarter, sample weights will be constructed for each quarter of the state-level study that reflect the various stages of sampling described earlier in Section 1.2.2. The calculation of the sampling weights will be based on the stratified, three-stage design of the study. Specifically, the person-level sampling weights will be the product of the three stagewise sampling weights, each of which is equal to the inverse of the selection probability for that stage. In review, the stages are as follows:

Stage 1: Selection of segment.

Stage 2: Selection of dwelling unit.
Three possible adjustments exists along with this stage of selection:
(1) Subsegmentation inflation – by-product of counting and listing
(2) Added dwelling unit – results from the half-open interval rule
(3) Subsampling / Release adjustment – from complications in field work.

Stage 3: Selection of person within a dwelling unit.
This stage also has a possible adjustment:
(1) Subsampling – same as at the dwelling unit level, from complications in field work.

A total of seven nondesign-based adjustments may be necessary for the calculation of the final analysis sample weight. All nondesign-based adjustments are implemented using a generalized exponential modeling technique. These are listed in the order in which they would be implemented:

1. *Outlier Treatment at the Dwelling Unit Level.* If it is determined that design-based weights (stages 1 and 2) along with any of their respective adjustments result in an unsatisfactory unequal weighting effect (i.e., variance between the dwelling unit level weights is too high), then high weights will be properly adjusted. This will be implemented by (a) identifying outlier weights (i.e., those weights outside the range of the median weight value $\pm$3*interquartile range for some domain of interest), (b) adjusting their weights to the outlier critical values (i.e., the smallest and largest values of the outlier range), and (c) reallocating the residual outlier weight (i.e., the outlier weight amount removed or added to adjust the weights to the outlier critical values) to units not identified as outliers. Possible domains of interest for this level adjustment are presented in Table 3.4.

2. *Nonresponse Adjustment at the Dwelling Unit Level.* This is to account for the failure to complete the within-dwelling unit roster. The potential list of variables for the 51 state main study dwelling unit nonresponse modeling are presented in Table 3.4.

3. *Dwelling Unit Level Post-Stratification.* This involves using screener data of demographic information (e.g., age, race, gender, etc.) Dwelling unit weights would be adjusted to the intercensal population estimates obtained from the U.S. Bureau of the Census' National Estimates and Projections Branch. In short, explanatory variables used during modeling would consist of counts of eligible persons within each dwelling unit that fall into the various demographic categories. Subsequently, these counts multiplied by the newly adjusted dwelling unit weight and summed across all dwelling units for various domains will add to the Census control totals. This adjustment is necessary for the proper calculation of pairwise weights, as well as, allow us to achieve greater precision in subsequent adjustments. Screener level potential variables are listed in Table 3.5.

4. *Outlier Treatment at the Person Level.* This would be implemented in the same manner as described above in nondesign based adjustment 1 except the weights would reflect the third stage of selection. Possible domains of interest are presented in both Table 3.4 and Table 3.5.

5. *Selected Person Weight Adjustment for Post-Stratification to Roster Data.* This step utilizes control totals derived from the dwelling unit roster that are equal to the Census estimates. This will assist in bias reduction and improve precision by taking advantage of the properties of a larger sample size. Selected person sample weights (i.e., those that have been adjusted at the dwelling unit level and account for third stage sampling) will be adjusted to the dwelling unit weight sums of all eligible rostered persons. Any demographic information used in modeling is based solely on screener information since this is the only information available for all rostered persons. Potential variables for this adjustment are a combination of the variables presented in Tables 3.4 and 3.5.

6. *Person Level Nonresponse Adjustment.* This adjustment allows for the correction of weights resulting from the failure of selected sample persons to complete the interview. Respondent sample weights will be adjusted to the total weight sum of all selected persons, adjusted for post-stratification to the eligible roster of persons. Again, demographic information used in modeling is based solely on screener information. Potential variables for this adjustment are a combination of the variables presented in Tables 3.4 and 3.5.

Table 3.4 Definitions of Levels for Proposed CAI Variables for Dwelling Unit and Person Level Adjustments

- Group Quarter Indicator
1: College Dorm,
2: Other Group Quarter,
3: Non-Group Quarter

- Percent of Owner-Occupied Dwelling Units in Segment (% Owner)
1: 0->10%,
2: 10%->50%,
3: 50%-100%

- Percent of Segments That are Black (% Black)
1: 0->10%,
2: 10%->50%,
3: 50%-100%

- Percent of Segments That are Hispanic (% Hispanic)
1: 0->10%,
2: 10%->50%,
3: 50%-100%

- Population Density
1: MSA $\geq$ 1,000,000,
2: MSA less than 1,000,000,
3: Non-MSA urban,
4: Non-MSA rural

- Quarter
1: Quarter 1,
2: Quarter 2,
3: Quarter 3,
4: Quarter 4

- Region
1: Northeast,
2: North-Central,
3: South,
4: West

- Segment Combined Median Rent and Housing Value (Rent/Housing)
1: First Quintile,
2: Second Quintile,
3: Third Quintile,
4: Fourth Quintile,
5: Fifth Quintile

- States

Interactions among the main effect variables are also considered.

Table 3.5 Definitions of Levels for Proposed CAI Variables for Dwelling Unit Post-Stratification and All Person Level Adjustments

- Age
1: 12-17,
2: 18-25,
3: 26-34,
4: 35-49,
5: 50+

- Gender
1: Male,
2: Female

- Hispanicity
1: Hispanic,
2: Non-Hispanic

- Quarter
1: Quarter 1,
2: Quarter 2,
3: Quarter 3,
4: Quarter 4

- Race
1: White,
2: Black,
3: Indian / Native American,
4: Asian

- Relation to Householder
1: Householder or Spouse,
2: Child,
3: Other Relative,
4: Non-Relative

Interactions among the main effect variables are also considered.

7. *Person Level Post-Stratification.* This step is to adjust the final person sample weights to the Census Bureau's estimates. These are the same outside control totals used in adjustment 3. However, explanatory variables for this adjustment are based on questionnaire data, not screener data as in adjustment 3. Data could differ between the two sources. Variables used in modeling are presented in Table 3.5.

All adjustments for the 1999 main study final analysis weights will be done with exponential adjustment factors derived from modeling the response variable with a generalized exponential regression formula. To help reduce computational burden at all adjustment steps, separate models will be fit for clusters of states, based on Census Region Division definitions as shown in Table 3.6. Furthermore, model variable selection at each adjustment will be done using a forward insertion process. The final adjusted weight will be the analysis weight for use in estimation. Table 3.7 presents a flow-chart of steps used in the weighting process and Table 3.8 displays all individual weight components.

Table 3.6 Model Group Definitions for CAI Modeling

Model	Defined State
1	Connecticut, Maine, New Hampshire, Rhode Island, Vermont, Massachusetts
2	New Jersey, New York, Pennsylvania
3	Illinois, Indiana, Michigan, Wisconsin, Ohio
4	Indiana, Kansas, Minnesota, Missouri, Nebraska, South Dakota, North Dakota
5	Delaware, District of Columbia, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia
6	Alabama, Kentucky, Mississippi, Tennessee
7	Arkansas, Louisiana, Oklahoma, Texas
8	Colorado, Iowa, Montana, Nevada, New Mexico, Utah, Wyoming, Arizona
9	Alaska, Hawaii, Oregon, Washington, California

Table 3.7 Flowchart of Sample Weighting Steps

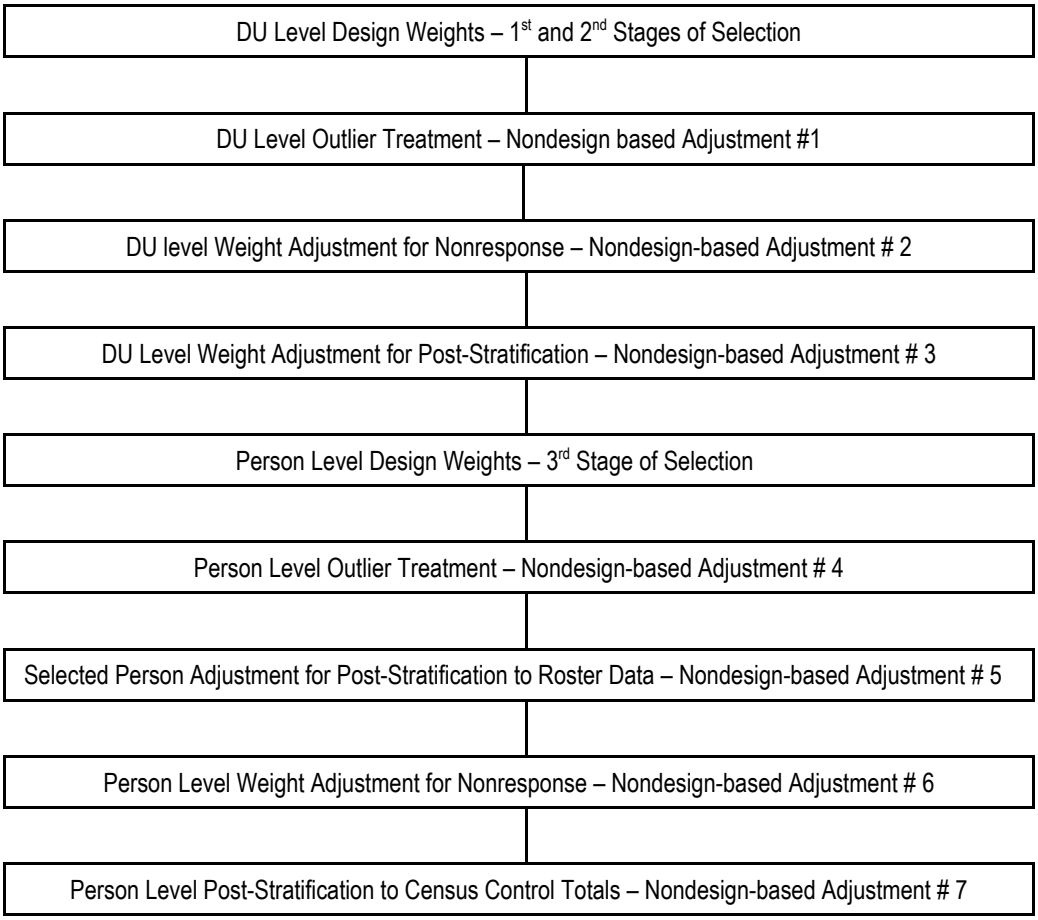

Table 3.8 CAI Sample Weight Components

DU Level Design Weight Components
1 Inverse Probability of Selecting Segment
2 Quarter Segment Weight Adjustment
3 Subsegmentation Inflation Adjustment
4 Inverse Probability of Selecting Dwelling Unit
5 Inverse Probability of Added Dwelling Unit
6 Dwelling Unit Subsampling / Release Adjustment
7 Dwelling Unit Outlier Treatment
8 Dwelling Unit Nonresponse Adjustment
9 Dwelling Unit Post-Stratification
Person Level Design Weight Components
10 Inverse Probability of Selecting a Person Within a Dwelling Unit
11 Person Subsampling Adjustment
12 Person Level Outlier Treatment
13 Roster Adjustment
14 Person Level Nonresponse Adjustment
15 Person Level Post-Stratification Adjustment

Full details of the finalized modeling procedures, as well as final variables used in each adjustment steps, can be found in the Sampling Weight Calibration for the 1999 NHSDA.

Chapter 4: General Sample Allocation Procedures for the Supplemental Study

This chapter discusses the computational procedures utilized to determine both person and dwelling unit sample sizes, as well as within dwelling unit age group-specific selection probabilities for the 1999 NHSDA Supplemental Study design. To maximize precision between the main study CAI estimates and the estimates generated from the PAPI supplemental sample, the design optimizations closely mirrored each other. For brevity sake, full details will not be included in this chapter because the same procedures are discussed in Chapter 3. Instead, what will be presented here are the differences or deviations in procedures among the two designs.

In review, some notable differences in the design include:

- Oversampling of both Hispanics and blacks, in addition to the younger age groups

- Four stages of selection (instead of three). There was an additional level of clustering at the first stage of selection. This additional clustering was introduced to minimize the costs associated with collecting the supplemental data by minimizing both the number of interviewers that needed to be trained on the PAPI instrument and the amount of counting and listing. In summary:

	Supplement Study (PAPI)	Main Study (CAI)
First Stage of Selection:	FI Regions	Segments
Second Stage of Selection:	Segments	Dwelling Units
Third Stage of Selection:	Dwelling Units	Persons
Fourth Stage of Selection:	Persons	N/A

Again similar to the main study, optimization procedures were designed to specifically address SAMHSA's multiple precision and design requirements while minimizing the cost of data collection. Minimization was achieved by determining the smallest number of interviews and selected dwelling units necessary to achieve the various design requirements. This required a four-step process:

1. Determine the optimal number of interviews (i.e., fourth stage of selection sample sizes) by domains of interest needed to satisfy precision requirements for several drug outcome measures. We sought to determine 90 unknown m_{wra} for each stratum w (6), each race r (3) and each age group a (5). A solution was found utilizing Chromy's Algorithm (Chromy, 1987). Details are given in Section 4.2.

2. Using the m_{wra}, determined above, the next step was to determine the number of segments necessary to achieve these sample sizes. Knowing the total number of segments required and that eight segments are selected within each FI region, one can calculate the number of FI regions to sample from the main study. Details are given in Section 4.3.

3. Using m_{wra} from the first step, we then determined the optimal number of selected dwelling units (D_{wj}), for each segment selected in 2 above and with segments classified into one of the six strata, necessary to meet our desired sample size and minimize costs. Similar to the main study, this was achieved quarterly through parameter constraints at the strata and segment level. Procedures for this step are further described in Section 4.4.

4. The fourth and final step in the optimization process entails determining age group and race specific probabilities (S_{wjra}) for each segment given m_{wra} and D_{wj} from 2 and 3 above. This was achieved utilizing a modification of Brewer's Method of Selection. Further details are presented in Section 4.5. After the calculation of both selection probabilities and required dwelling unit sample sizes, sample size constraints both at the screening level and interview level were applied. Note that because of the split sampling (main and supplemental) occurring in the same segments, these constraints were applied to the combined sample of both studies, not individually.

4.1 Notation

a = Age Group. a=1..5 and represents the following groups: 12 to 17 year olds, 18 to 25 year olds, 26 to 34 year olds, 35 to 49 year olds, and 50+ year olds, respectively.

j = Individual segment indicator (total of 2,000; 500 per quarter) These segments are a subsample of the 7,200 segments in the main study.

r = Race. r =1..3 and are defined as follows*:* Hispanic, black non-Hispanic, and nonblack non-Hispanic, respectively. For brevity sake, these will be referred to as Hispanic, black, and white. Including race classifications allowed for the optimal oversampling of minority groups.

w = Design Parameter Estimated Strata. The definitions for each strata are the same as those presented in Section 3.1; however, unlike the main study which classifies strata at the segment level, these are classified at the FI region level. Subsequently, all segments in the same FI region are within the same strata.

s = Design Parameter Estimated Strata. These classifications parallel the main study by grouping each segment into a strata based on the characteristics of the individual segment. These strata definitions are the same as those presented in Section 3.1. This shift in strata classification was necessary to facilitate estimating necessary rates, particularly in cases where sample sizes were inadequate at the FI region level.

m_{wra} = Number of completed interviews (person respondents) desired in each strata w, race r, and age group a. Computation of m_{wra} is discussed in Section 4.2. For purposes of quarterly computation of selected dwelling unit sample size, 25% of the yearly estimate was used.

y_{wra} = Estimated number of persons in the target population in the strata w, race r, and age group a. These values were computed using the adjusted Census block counts, as described in Section 3.1. The block values were aggregated to the FI region level, then each FI region was classified into one of the six strata.

f_{wra} = m_{wra} / y_{wra}. Strata, race, and age group-specific sampling fraction.

F_w = Max$\{f_{wra}$; r=1..3, a=1..5$\}$.

P_{wj} = Inverse of the Segment Selection Probability. To reduce costs, we visited a subsample of the main study selected segments. This subsample consisted of all segments within a randomly selected FI region. In short, each segment's selection probability consists of the FI region selection probability and the selection probability of the segment within the FI region. Since each quarter only consists of 25% of the segment sample, selection probabilities were further adjusted by a factor of 4 to sum to the yearly totals.

I_{wj} = Subsegmentation Inflation Factor. This is described in Section 3.1.

D_{wj} = Minimum number of dwelling units to select for screening in segment *j* to meet the targeted sample sizes for each strata *w*, race *r*, and age group *a*.

L_{wj} = Final Segment count of dwelling units available for screening.

S_{wjra} = Strata, segment-specific probability of selecting a person in race *r* and age group *a*. As with the main study, no single selection probability could exceed one.

ε_s = Stratum, s, specific dwelling unit eligibility rate. Derived from 1997 NHSDA data using a logistic regression model and classifying all 1997 segments into the 1999 stratum definitions. All 1999 NHSDA segments defined within the same stratum received the same rate.

φ_s = Stratum, *s*, specific, screening response rates. Calculated using the same methodology as described for the dwelling unit eligibility rate (ε_w).

λ_{sra} = Stratum *s*, race *r*, and age group *a* specific interview response rate. Using data from the 1997 NHSDA, the additive effects of stratum, race and age group on interviewer response were determined using a constrained, weighted logistic model.

γ_{sra} = Expected number of persons within an age group per dwelling unit. Calculated using 1997 NHSDA data by dividing the weighted total number of rostered persons in a race *r* and age group *a* by the weighted total number of screener-complete dwelling units for each stratum *s*.

δ_{sra} = Stratum *s*, race *r*, and age group *a* specific maximum-of-two rule adjustment. The survey design restricts the number of interviews per dwelling unit to a total of two. This is achieved through a modified Brewer's method of selection. This results in a loss of potential interviews in dwelling units where selection probabilities sum to more than two. The adjustment is designed to inflate the number of required dwelling units to compensate for this loss. This procedure is iterative and utilizes 1997 NHSDA data as follows:

(Note that, since prior NHSDA data were unavailable for each segment, maximum-of-two rule adjustments were computed at the stratum level.)

1. *Determine the number of dwelling units* (R_{wra}). Determine the quantity necessary to obtain desired person sample sizes given the desired sample sizes in each stratum, race and age group.

$$R_{wra} = \frac{m_{wra}}{(\varepsilon_s * \varphi_s * \lambda_{sra} * \gamma_{sra} * \delta_{sra})} \quad where\ \delta_{sra} = 1\ for\ first\ iteration \tag{13}$$

2. *Set S_{wra} = .99 for the race and age group with the largest R_{wra}.* All other race and age group probabilities are set in proportion to the largest:

$$S_{wra} = \frac{R_{wra}}{Max(R_{wra})} \tag{14}$$

For quarter 1, we used historic NHSDA results to determine a priori, which race and age group would require the most dwelling units to achieve its desired sample. They are as follows:

Stratum	Age Group and Race
1: High Hispanic	12 to 17 Hispanic
2: High Black	18 to 25 Black
3: High Minority	12 to 17 Black
4: High White	12 to 17 White
5: Medium White	18 to 25 Black
6: Remainder	12 to 17 Black

However, in actually computing S_{wra}, it was soon discovered that the race and age group that we set as the 'Driving' group, did not always require the maximum number of dwelling units. In short, this caused S_{wra} to be greater than one, clearly a violation of our design. To compensate for this, all S_{wra} greater than .99 were truncated back to .99.

3. *Assign S_{wra} to respective person record in 1997 NHSDA data.* With the modified Brewer's Method, selection probabilities are now adjusted to reflect the total household composition. In short, if selection probabilities for all eligible dwelling unit members sum to more than two, then probabilities are ratio adjusted to sum to two. This will be denoted as S^*_{wra}. However, sums less than two are unadjusted.

4. *Sum S_{wra} and S^*_{wra} within stratum.* The maximum-of-two rule (δ_{sra}) is then calculated as the ratio of the summed S^*_{wra} and S_{wra} (i.e., $\Sigma\, S^*_{wra} / \Sigma\, S_{wra}$).

5. *Insert new calculated δ_{sra} into Step 1 and repeat Steps 1 through 5.* Continue until the absolute difference between δ_{sra} of the current cycle and the previous cycle is less than .001, usually about three to four iterations.

4.2 Determining Person Sample Sizes by Stratum, Race, and Age Group

This initial optimization step was set up to minimize the total NHSDA respondent sample size needed to meet both the 90 domains of interest and precision requirements established by SAMHSA on a generic prevalence of 10%. In summary, these precision requirements on the relative standard error (RSE) of an estimate of 10% for SAMHSA's 17 subpopulations of interest are:

- RSE = 3.40% for total, national population
- RSE = 6.75% for the national population in each of the four age groups: 12 to 17 year olds, 18 to 25 year olds, 26 to 34 year olds, and 35+ year olds.
- RSE = 7.50% for the population within each of the four age groups for whites (i.e., nonblack, non-Hispanic).
- RSE = 11.25% for the population within each of the four age groups for blacks (i.e., black, non-Hispanic).
- RSE = 11.25% for the population within each of the four age groups for Hispanics.

As had been done in previous NHSDA designs, we continued to use an expanded age group stratification: 12 to 17, 18 to 25, 26 to 34, 35 to 49, and 50+. This still parallels SAMHSA's subpopulations of interest, as implied by the precision constraints. This decision allows for a decrease in the 35+ sample while still meeting the precision requirement. Since substance abuse is more prevalent among 35 to 49 year olds than 50+ year olds, oversampling this younger age group will increase the precision of generated estimates for the 35+ year olds, while simultaneously minimizing the total number of 35+ needed in the sample.

To form precision constraints that reflect the above standard error requirements, we have set up a preliminary Step-1 Optimization using (1) design effects estimated from the 1994-1996 NHSDA data, (2) population counts obtained from Claritas, Inc., and (3) various outcome measures that were estimated for each block group in the United States from our recently completed 1991-1993 NHSDA SAE project. Appropriate variance constraints were defined for nine outcome measures of interest. These outcome measures of interest were included to address not only the NHSDA recency-of-use estimates but also such related generic substance abuse measures as treatment received for alcohol and illicit drug use and dependency on alcohol and illicit drug use. These nine outcome measures are the same as those described in Section 3.2 for the main study.

Table 4.1 displays the final stratum by race by age groups sample size allocation for the entire 1999 NHSDA survey year. An original total sample size of 20,000 respondents was expected for the entire year,

Table 4.1 Supplemental Study Sample Size by Strata, Race, and Age Group

Strata	Total						Hispanic					
	Total	12-17	18-25	26-34	35-49	50+	Total	12-17	18-25	26-34	35-49	50+
Total	15,000	3,562	3,782	3,468	2,410	1,779	3,332	904	831	810	520	268
High Hispanic	1,015	299	268	234	140	74	802	254	214	179	105	51
High Black	624	172	196	144	66	47	29	7	7	8	5	2
High Minority	642	156	148	170	101	67	241	66	53	64	38	20
High White	3,607	846	917	763	589	493	182	34	45	54	31	18
Medium White	4,127	931	1,058	952	667	520	633	156	172	155	98	53
Remainder	4,985	1,158	1,196	1,205	847	580	1,447	388	341	351	243	125

Strata	Black Non-Hispanic						Nonblack Non-Hispanic					
	Total	12-17	18-25	26-34	35-49	50+	Total	12-17	18-25	26-34	35-49	50+
Total	3,343	845	950	857	431	262	8,325	1,814	2,001	1,802	1,460	1,250
High Hispanic	100	23	25	30	14	8	113	23	29	26	21	14
High Black	553	157	180	127	53	37	43	8	9	10	8	8
High Minority	278	68	71	74	39	26	124	22	24	32	24	22
High White	103	19	23	26	24	11	3,323	794	849	683	534	464
Medium White	868	226	262	217	104	60	2,627	549	625	580	466	407
Remainder	1,442	353	390	383	197	120	2,096	418	465	472	407	335

which would be equally allocated to each of the four quarters. As a result of unexpected higher yields in the first quarter and a desire to concentrate on the main study, the supplemental sample was reduced to approximately 15,000 desired respondents. The expected sample sizes were allocated to 5,000 for quarters 1 and 2 and a sample of 2,500 in quarters 3 and 4. Details of the reasons behind this sample reduction can be found in Appendix B.

4.3 First and Second Stages of Selection: Determining the Number of Segments and Corresponding FI Regions

The supplemental sample first stage sampling units are comprised of 250 primary sampling units (PSUs). Unlike the main study which uses FI region as a stratification variable, the supplemental sample defines FI region as its PSU. The clustering of PSUs was implemented to achieve the desired precision and comparability requirements while simultaneously reducing costs. Probability proportional to size (PPS) and with minimum replacement sampling of the 900 CAI FI regions was implemented. To maintain consistency between CAI and PAPI, the second-stage PAPI sampling units consisted of the 2000 segments defined within the 250 selected FI regions.

4.3.1 Initial Stratification and Formation of the Composite Size Measures

FI regions were explicitly stratified into six categories using 1990 Decennial Census data supplemented with revised population counts from another source. These strata are defined in Table 1.1.

Composite size measures were then defined using the methodology described in Section 2.1, at the FI region level rather than the Census block level. Table 4.2 displays the sampling rates $f_h(d)$ at which we wished to sample each race/ethnicity by age group domain d from stratum h. Although the sample sizes were modified as described in Section 1.2, the composite size measures and FI region selections were not changed. Thus, the numerators of the sampling rates correspond to the sample sizes as originally planned and the denominators are sampling frame person counts of race/ethnicity by age group according to the 1990 Census supplemented with revised population counts.

Table 4.2 1999 NHSDA PAPI Sampling Rates Used to Form Composite Size Measures

Race	Age Group	High Hispanic	High Black	High Minority	High White	Medium White	Remainder
Hispanic	12-17	338	9	88	45	208	517
		777,492	25,904	221,374	182,255	499,942	1,218,331
	18-25	285	9	71	60	229	454
		884,425	29,440	254,748	249,484	665,261	1,426,703
	26-34	237	10	85	73	207	468
		1,136,480	42,278	363,830	300,161	872,473	2,020,080
	35-49	140	7	51	41	130	324
		1,626,262	66,897	548,531	501,250	1,335,130	3,135,942
	50+	68	3	26	24	70	166
		1,649,016	68,541	586,643	614,904	1,499,800	3,359,954

(continued)

Table 4.2 1999 NHSDA PAPI Sampling Rates Used to Form Composite Size Measures (continued)

Race	Age Group	High Hispanic	High Black	High Minority	High White	Medium White	Remainder
Black	12-17	30	208	91	25	301	470
		119,814	372,468	288,166	204,360	857,573	1,522,590
	18-25	33	240	93	30	349	520
		153,770	429,374	331,916	340,420	1,077,833	1,797,298
	26-34	40	169	99	35	289	510
		167,601	539,296	413,870	326,394	1,237,822	2,168,682
	35-49	19	70	51	32	138	263
		246,829	880,117	679,515	431,346	1,794,029	3,354,824
	50+	11	49	34	15	80	160
		216,389	956,934	701,807	310,219	1,632,063	3,190,514
White	12-17	31	11	29	1,058	731	557
		209,740	76,237	203,931	7,484,614	5,088,879	3,756,819
	18-25	39	12	32	1,132	833	620
		300,920	93,002	255,588	9,010,233	6,259,970	4,647,499
	26-34	34	13	43	909	773	629
		346,521	140,128	437,827	10,516,687	8,195,317	6,391,699
	35-49	28	11	32	712	621	542
		609,788	246,499	750,395	19,894,027	15,225,353	11,744,988
	50+	19	10	29	618	543	447
		654,787	368,424	1,074,265	27,724,666	21,360,397	15,562,060

4.3.2 FI Region Selection for the Supplemental Sample

For the 1999 NHSDA supplemental sample, Chromy's probability-minimum-replacement sequential-sampling procedure (Chromy, 1979) was used to select a sample of 250 FI regions. Through an optimization using cost and Hispanic population as key factors, the selected number of FI regions per stratum was computed by dividing the desired number of interviews per stratum by the average number of expected respondents per FI region. Table 4.3 summarizes the desired number of interviews per stratum along with the required number of FI regions.

Table 4.3 1999 NHSDA PAPI Number of Selected FI Regions Per Race/Ethnicity Stratum

Stratum	Number of Required Interviews	Number of FI Regions (n_n)
1	1,015	17
2	624	10
3	642	11
4	3,607	60
5	4,127	69
6	4,985	83
Total	15,000	250

The expected frequency of selection is given by:

$$P_{hi} = n_h S_{hi+} / S_{h++} \quad (15)$$

where n_h is the selected number of FI regions for each specific stratum and S_{h++} is the sum of the composite size measure over FI regions in each stratum. To make 250 FI region selections from the frame of 900 FI regions, Chromy's procedure partitioned the FI regions, based upon their size measures S_{hi+}, into n_h zones of equal size (individual FI regions may have straddled zone boundaries) for each explicit stratum. The selection of FI regions was independent between stratum. Exactly one sample FI region was then randomly selected from each zone. This zoned sequential selection made possible a deep implicit stratification of PSUs by a controlled ordering of the first-stage frame. Moreover, the zones were defined so that all pairs of PSUs had a chance of appearing together in the sample, a requirement for unbiased estimation of sampling variances (Chromy, 1981).

The probability-minimum-replacement feature of Chromy's procedure refers to the treatment of PSUs for which the expected number of selections exceeds one (e.g., self -representing PSUs). The actual number of times a PSU can be selected for the sample differs from the expected number by less than one, and the average number of selections over all possible implementations of Chromy's procedure equals the expected number.

Using data estimated from the 1990 Census supplemented with revised population counts, a serpentine ordering was implemented by state and the percent of noninstitutional civilian minority population age 12 or older for each FI region. The serpentine nature of the sort maximizes the similarity of adjacent FI regions in the ordered list. More specifically, FI regions were ordered first by state. Therefore the list is ordered such that FI regions within a state are contiguous. The next level of ordering is by percent minority. This ordering within state places FI regions with similar racial populations adjacent to each other.

4.4 Third-Stage Sample Allocation for Each Segment

Given the desired respondent sample size for each strata, race, and age group (m_{wra}) needed to fulfill the design requirements established by SAMHSA, the next step was to compute the minimal number of dwelling units to select for each segment. These calculations were performed on a quarterly basis to take

advantage of differences in segment characteristics within each quarter and to allow for design parameter adjustments. The procedures described below are Quarter 1 specific and deviations from these are described in full detail in Section 4.8.

The formula that was utilized to optimally minimize the required dwelling unit sample is as follows:

$$f_{wra} = P_{wj} * I_{wj} * \left(\frac{D_{wj}}{L_{wj}}\right) * S_{wjra} * \varphi_s * \lambda_{sra} * \delta_{sra} \tag{16}$$

At this point in the procedure, only two components in the formula are unknown: D_{wj} and S_{wjra}. Selection probabilities are segment, race and age group specific and to maximize the number of selected persons within a dwelling unit, the age group whose sampling fraction (f_{wra}) = F_w , known now as the "Driving Age Group," was set to the largest allowable selection probability (S_{hwja}) of .99. For quarter 1, specific race and age groups were set as the "driving age group" for each strata regardless of their respective f_{wra}, as described above in Section 4.1. Thus, we solved for D_{wj} for each of the pre-specified driving race and age groups:

$$D_{wj} = \frac{f_{wra}}{(P_{wj} * I_{wj} * S_{wjra} * \varphi_s * \lambda_{sra} * \delta_{sra})} * L_{wj} \tag{17}$$

4.5 Determining Fourth-Stage Sample (Person) Selection Probabilities for Each Segment

Having solved for D_{wj}, we then solved the selection probabilities for the remaining age groups. If the resulting probability was greater than 0.99, we truncated the value to 0.99. As noted in the above section, the pre-specified race and age group did not always require the maximum number of lines. Thus for many race and age group combinations S_{wjra} were greater than 0.99. If $L_{wj} = 0$ and subsequently $D_{wj} = 0$, then all $S_{wjra} = 0$.

$$S_{wjra} = \frac{f_{wra}}{P_{wj} * I_{wj} * \left(\frac{D_{wj}}{L_{wj}}\right) * \varphi_s * \lambda_{sra} * \delta_{sra}} \tag{18}$$

During the fielding of the quarter 1 sample, it was discovered that race-specific selection probabilities had been assigned to the incorrect race groups. In short,

Original	Actual
Hispanic	nonblack, non-Hispanic
black, non-Hispanic	Hispanic
nonblack, non-Hispanic	black, non-Hispanic

To help correct this error, the new probabilities were calculated for both black, non-Hispanics and nonblack, non-Hispanics, which included a probability reduction of 20% and 50%, respectively. Then, the probabilities were correctly assigned to the proper race and age group.

4.6 Sample Size Constraints

The supplemental study sample as well as the main study sample were constrained by certain restrictions to guarantee a sufficient sample for both additional studies and subsequent survey years that revisit the same segments. In addition, these constraints were implemented to reduce field interviewer burden. All constraints were previously described in Section 3.5.

As in the main study, constraints could reduce the dwelling unit (third-stage) sample. This in turn could potentially reduce the expected person (fourth-stage) sample size. Therefore, any reduction in the third-stage sample was reallocated back to the segments by applying a marginal adjustment to the fourth-stage sample size (m_{wra}) at the strata, race and age group level. Note that, when applying this marginal adjustment, age groups 35 to 49 and 50+ were treated as one group. As a result, segments that were not subject to these constraints could have been affected. This adjustment to reallocate the dwelling unit sample was iterative until the expected person sample sizes were met. Note that the optimization procedures implemented for the derivation of D_{wj} assign the larger dwelling unit samples to segments with better response rates. Often such segments are the first to be affected by the sample size constraints. Hence, when forced to reallocate the reduction in dwelling unit sample size to segments with poorer response rates, the overall dwelling unit sample size increased in a nonlinear amount. In short, segments with worse response rates require more screened dwelling units per completed interview. Unlike the main study, these adjustments were applied during quarter 1.

4.7 Dwelling Unit Selection and Release Partitioning

After derivation of the required dwelling unit sample size (D_{wj}), the sample was selected from the frame of counted and listed dwelling units for each segment (L_{wj}). The frame was ordered in the same manner as described in Section 3.3.1 and selection was completed using systematic sampling with a random start value.

Because of complications in quarter 1 (e.g., insufficient FI staff, reduced quarter time frame resulting from training and greater-than-expected PAPI workload), a decision to reduce the sample size was made. This decision was made to minimize the effect on response rates, since released dwelling units that were unworked were classified as nonrespondents and to further reduce FI burden by establishing a workload goal that was obtainable within the remaining quarter 1 time frame. Details on the mechanics of quarter 1 subsampling can be found in Appendix B.

Problems with the implementation of an inter-quarter subsampling, along with the effects of unequal weighting associated with subsampling, prompted a sample partitioning procedure to be implemented starting in quarter 2. The entire sample (D_{wj}) was still selected, but only certain percentages of the total were released into the field. An initial percentage was released to all segments at the beginning of the quarter and, based on inter-quarter work projections, additional percentages were released if it was concluded that field staff could handle the added workload. Each partitioning of the sample is a valid sample and helps to control the amount of nonresponse without jeopardizing the validity of the study. Incidentally, in some quarters, a reserve sample was also selected over and above the required D_{wj} sample to compensate for any shortcomings experienced in previous quarters. A summary of the quarterly sample sizes and percents released is provided in Table 4.4.

Table 4.4 Quarterly Dwelling Unit Sample Sizes and Percent Released for the Supplemental Study

Strata	Quarter 1			Quarter 2		
	# Sampled	# Released	%	# Sampled	# Released	%
Total	25,861	18,408	71	20,932	13,863	66
High Hispanic	1,831	1,456	80	2,473	1,686	68
High Black	3,112	1,975	63	3,057	2,005	66
High Minority	488	317	65	1,277	755	59
High White	9,940	7,228	73	4,315	2,852	66
Medium White	6,207	4,252	69	5,992	3,982	66
Remainder	4,283	3,180	74	3,818	2,583	68

Strata	Quarter 3			Quarter 4		
	# Sampled	# Released	%	# Sampled	# Released	%
Total	7,546	6,495	86	7,260	7,260	100
High Hispanic	524	437	83	646	646	100
High Black	1,115	966	87	879	879	100
High Minority	240	212	88	233	233	100
High White	2,798	2,411	86	2,733	2,733	100
Medium White	1,582	1,372	87	1,921	1,921	100
Remainder	1,287	1,097	85	848	848	100

4.8 Quarter-by-Quarter Deviations

The following section describes corrections and/or modifications that were implemented in the process of design optimization. *Design* refers to deviations from the original proposed plan of design. *Procedural* refers to changes made in the calculation methodologies. Even though *Constraints* could be included under both *Design* and *Procedural*, it was felt that they were important enough to be addressed separately. Finally, *dwelling unit Selection* will address changes that occurred after sample size derivations. Specifically, corrections implemented during fielding of the sample (i.e., sample partitioning as described in Section 4.7). Quarter 1 deviations are not included since the methods and procedures described above were all implemented in quarter 1. Subsequently, any changes would have been made after quarter 1. Note that no changes from the quarter 1 dwelling unit selection process were implemented in subsequent quarters. Hence, this section will only include changes in release partitioning and subsampling.

Quarter 2

Design: Because of unexpected higher yields in quarter 1, the sample was reduced in size to 4,500. This reduction was applied equally to all strata, race, and age groups by a simple ratio adjustment of (4,500 / 5,000).

Procedural: Again, because of unexpected higher yields, it was determined to reevaluate the assignment of the "driving race and age group." Instead of following the predetermined race and age group, a maximum sampling rate was determined for each race and then a maximum of these three was computed. If the maximum rate was from the Hispanic or black, non-Hispanic race groups then a criteria of greater than 10% of the segment population had to be comprised of a combination of the two groups. Otherwise, the maximum rate for the nonblack, non-Hispanic group was assigned as the "driving race and age group." No criteria were necessary if the nonblack, non-Hispanic group was originally determined to be the maximum rate of all three race compositions. This in turn helped to reduce the necessity for selection probability truncation to .99.

Constraints: No Changes

Dwelling Unit Selection: No interquarter subsampling. Quarter 2 D_{hj} sample is allocated out to field supervisors (FSs) in the following release percentages:

Release 1: 50% of entire sample (100% of sample in even-numbered segments)
Release 2: 1/6 of entire sample (1/3 of sample in odd-numbered segments)
Release 3: 1/6 of entire sample (1/3 of sample in odd-numbered segments)
Release 4: 1/12 of entire sample (1/6 of sample in odd-numbered segments)
Release 5: 1/12 of entire sample (1/6 of sample in odd-numbered segments)

Note that this is the same as for the main study.

Quarter 3

Design: There was a further reduction in sample size to 2,500. An additional 20% was added as a reserve and, if feasible, would be released into the field to compensate for sample lost from size reductions. Also segments were redefined into the same six strata definitions, except demographic criteria were based on the individual segment characteristics not the FI region. In short, the *w* in notation was switched to *s*.

Procedural: Same procedural changes as those described for the main study quarter 3 allocation, described in Section 3.7. In addition, the race and age group that required the maximum number of dwelling units to be selected, was assigned as the "driving race and age group." In short, the predetermined race and age groups were ignored and the segment population percentage criteria removed. This also eliminated the need to truncate selection probabilities greater than .99, because only one of the 15 possible race and age combinations could be assigned a probability of .99. All other selection probabilities were scaled down in relation to this value.

Constraints: Same as those implemented in quarter 2 plus the requirement that any segment with at least 10 listed dwelling units would have a minimum of five selected dwelling units to be screened (for cost purposes).

Dwelling Unit Selection: As implemented in quarter 2, the D_{sj} sample was allocated out in the following release percentages:

Release 1: 50% of original supplemental sample
Release 2: 25% of original supplemental sample
Release 3: 25% of original supplemental sample
Release 4: 50% of reserve sample (20% of original supplemental sample)
Release 5: 50% of reserve sample (20% of supplemental sample)

Note that, unlike quarter 2, the release percentages are now applied at the FI region level instead of the FS region level.

Quarter 4

Design: Sample Size Adjustments. Again the same as in quarter 3, a reduction to a sample of 2,500. In this quarter a reserve sample of only 10% was applied.

Procedural: Proceeded with the same changes as implemented in quarter 3.

Constraints: Proceeded with same changes as implemented in quarter 3.

Dwelling Unit Selection: Same procedures as occurred in quarter 3 with the following release percentages:

Release 1: 100% of original supplemental sample.
Release 2: 100% of reserve sample (10% of original supplemental sample)

Note that this was a derivation from the main study release allocation.

4.9 Sample Weighting Procedures

At the conclusion of data collection for the last quarter, sample weights were constructed for each quarter of the National-level study that reflect the various stages of sampling described earlier in Section 1.2.3. The calculation of the sampling weights was based on the stratified, four-stage design of the study. Specifically, the person-level sampling weights are the product of the four stagewise sampling weights, each of which is equal to the inverse of the selection probability for that stage. In review, the stages are as follows:

Stage 1: Selection of FI region.

Stage 2: Selection of segment.

Stage 3: Selection of dwelling unit.
Three possible adjustments exists along with this stage of selection:
(1) Subsegmentation inflation – by-product of counting and listing;
(2) Added dwelling unit – results from the half-open interval rule;
(3) Subsampling / Release adjustment – from complications in field work.

Stage 4: Selection of person within a dwelling unit.
This stage also has a possible adjustment:
(1) Subsampling – same as at the dwelling unit level, from complications in field work.

A total of four nondesign-based adjustments were necessary for the calculation of the final analysis sample weight. All nondesign-based adjustments were implemented using a generalized exponential modeling technique. These procedures and adjustments paralleled those used in previous survey years, to maintain a consistency. The nondesign-based adjustments are listed in the order in which they were implemented:

1. *Nonresponse Adjustment at the Dwelling Unit Level.* This is to account for the failure to complete the within-dwelling unit roster. The potential list of variables for the National study dwelling unit nonresponse modeling are presented in Table 4.5.

2. *Person Level Nonresponse Adjustment.* The next step was to adjust the sample weights of the interview respondents to the weighted demographic distributions based on the full roster sample and associated final weights for screened eligible dwelling units. This weight adjustment tended to be the largest adjustment imposed on the sample weights for the NHSDA and was constructed to simultaneously compensate for the sampling error associated with the roster subsampling and for the bias associated with interview nonresponse. Potential variables for this adjustment were a combination of the variables presented in Tables 4.5 and 4.6.

3. *Weight Trimming Factor.* This step is to reduce the effect of extreme weights on the unequal weighting effect observed among the unconditional sample weights up to this point, the high extreme sample weights were truncated or "trimmed." This was unlike the CAI, which examined extreme weights at both ends of the spectrum. To accomplish this weight trimming, we examined the critical value (for the outlier definition) of the unconditional sample weights among the responding people within classes defined by design strata, race/ethnicity, and age group. If the unconditional sample weight for any respondent was greater than this threshold, then this adjustment factor was set to proportionally bring the sample weight down to equal the threshold.

4. *Person Level Post-Stratification.* The final adjustment was to force weighted respondent sample data to equal specified control totals obtained from the Census Bureau's estimates of the civilian, noninstitutionalized population aged 12 or older. Unlike the CAI post-stratification, which required state-level controls, national level estimates of the target population for various domains were directly available from the Census Bureau post-Censal estimation program. Variables examined for modeling were the same as those presented in Table 4.6.

Table 4.5 Definitions of Levels for Proposed PAPI Variables for Dwelling Unit and Person Level Adjustments

- Group Quarter Indicator
1: College Dorm,
2: Other Group Quarter,
3: Non-Group Quarter

- Percent of Owner-Occupied Dwelling Units in Segment (% Owner)
1: 0->10%,
2: 10%->50%,
3: 50%-100%

- Percent of Segments That are Black (% Black)
1: 0->10%,
2: 10%->50%,
3: 50%-100%

- Percent of Segments That are Hispanic (% Hispanic)
1: 0->10%,
2: 10%->50%,
3: 50%-100%

- Population Density
1: MSA $\geq$ 1,000,000,
2: MSA less than 1,000,000,
3: Non-MSA urban,
4: Non-MSA rural

- Quarter
1: Quarter 1,
2: Quarter 2,
3: Quarter 3,
4: Quarter 4

- Region
1: Northeast,
2: North-Central,
3: South,
4: West

- Segment Combined Median Rent and Housing Value (Rent/Housing)
1: First Quintile,
2: Second Quintile,
3: Third Quintile,
4: Fourth Quintile,
5: Fifth Quintile

Interactions among the main effect variables are also considered.

Table 4.6 Definitions of Levels for Proposed PAPI Variables for Dwelling Unit Post-Stratification and All Person Level Adjustments

---

- Age
1: 12-17,
2: 18-25,
3: 26-34,
4: 35-49,
5: 50+

- Gender
1: Male,
2: Female

- Hispanicity
1: Hispanic,
2: Non-Hispanic

- Quarter
1: Quarter 1,
2: Quarter 2,
3: Quarter 3,
4: Quarter 4

- Race
1: White,
2: Black,
3: Indian / Native American,
4: Asian

- Relation to Householder
1: Householder or Spouse,
2: Child,
3: Other Relative,
4: Non-Relative

Interactions among the main effect variables are also considered.

All adjustments for the 1999 National Study final analysis weights were done with exponential adjustment factors derived from modeling the response variable with a generalized exponential regression formula. To help reduce computational burden at all adjustment steps, separate models were fit for each stratum, as defined previously. Furthermore, model variable selection at each adjustment was done using a forward insertion process. The final adjusted weight was the analysis weight for use in estimation. Table 4.7 presents a flow-chart of steps used in the weighting process and Table 4.8 displays all individual weight components.

Full details of the finalized modeling procedures as well as final variables used in each of the adjustment steps can be found in the Sampling Weight Calibration for the 1999 NHSDA.

Table 4.7 Flowchart of Sample Weighting Steps

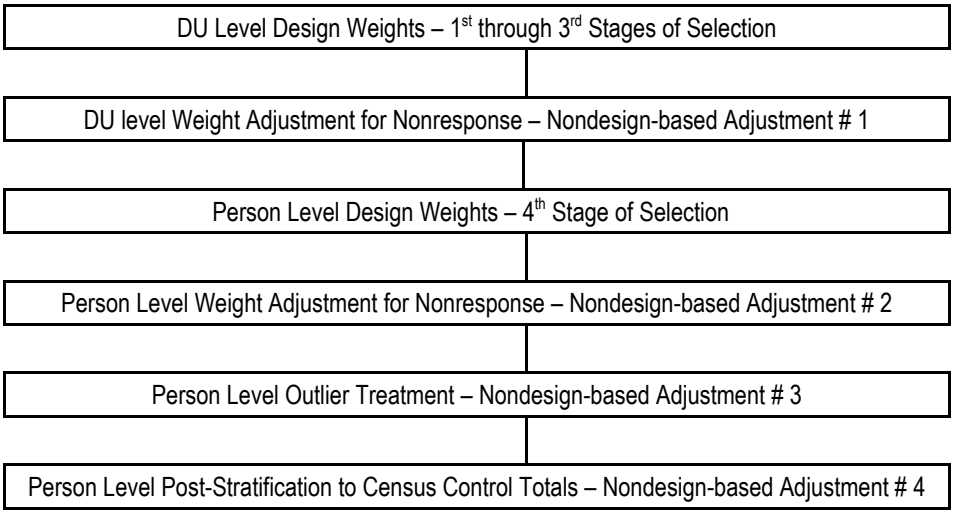

Table 4.8 PAPI Sample Weight Components

DU Level Design Weight Components	
# 0	Inverse Probability of Selecting a FI Region
# 1	Inverse Probability of Selecting Segment
# 2	Quarter Segment Weight Adjustment
# 3	Subsegmentation Inflation Adjustment
# 4	Inverse Probability of Selecting Dwelling Unit
# 5	Inverse Probability of Added Dwelling Unit
# 6	Dwelling Unit Subsampling / Release Adjustment
# 7	Dwelling Unit Nonresponse Adjustment
Person Level Design Weight Components	
# 8	Inverse Probability of Selecting Person Within Dwelling Unit
# 9	Person Subsampling Adjustment
# 10	Person Level Nonresponse Adjustment
# 11	Weight Trimming Adjustment
# 12	Person Level Post-Stratification Adjustment

4.10 Creation of Variance Estimation Strata

Because of the nature of the stratified clustered sampling design, it is essential that the design structure is taken into consideration when computing variances of survey estimates. While key nesting variables were created to capture explicit stratification and to identify clustering for the 5-year sample (Section 2.5), additional nesting variables had to be created to reflect the design of the supplemental sample. For the 1999 NHSDA supplemental sample, we followed similar procedures for creating variance estimation strata that we have used since the 1988 NHSDA. Adjacent design strata were collapsed into pairs to create pseudo-strata with primarily two replicates each.

For the 1999 NHSDA supplemental sample, we grouped the PSUs into sets based upon their sequential order of selection. These variance strata are comprised of two or three FI regions that were selected consecutively in the selection algorithm. Each variance stratum should be identical in respect to the explicit stratification and similar with respect to the implicit stratification that was utilized in the PSU selection. As a result, each explicit stratum has unique pseudo-strata. Each set of PSUs defined a pseudo-stratum with two or three replicates. More specifically within a variance stratum, the first FI region to be selected of the two or three replicates would be designated at the first variance replicate, and the next would be the second replicate. A third replicate per variance stratum occurred if the last variance stratum for the explicit stratum would only be comprised of one replicate. In this case, the last FI region would be added as the third replicate to the previous variance stratum in the specific explicit stratum. This exception occurs since at least two replicates per variance stratum are required to compute a variance.

All weighted statistical analyses for which variance estimates are needed should use the pseudo-strata and replicate identifying variables to identify nesting. Variance estimates can be computed by using clustered data analysis software packages such as SUDAAN (Shah, 1997). The SUDAAN software package computes variance estimates for nonlinear statistics using procedures such as a first-order Taylor series approximation of the deviations of estimates from their expected values. The approximation is unbiased for sufficiently large samples.

Chapter 5: References

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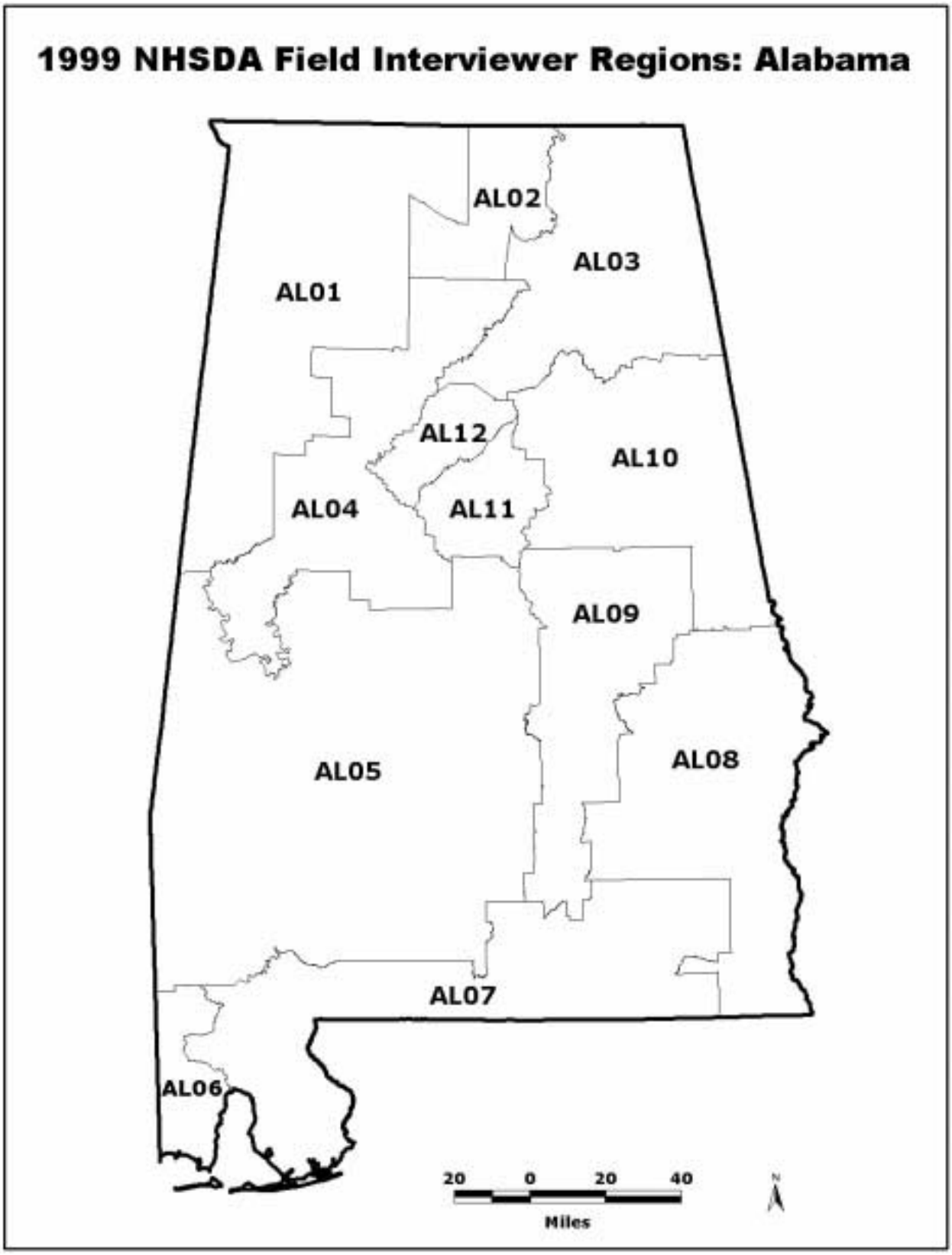
Appendix A

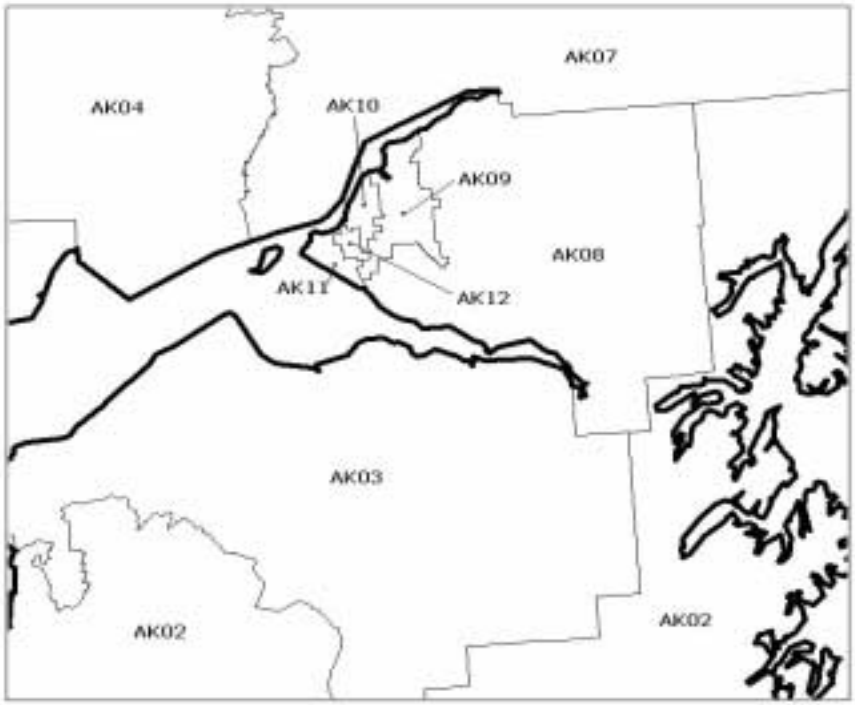
1999 NHSDA Field Interviewer Regions


1999 NHSDA Field Interviewer Regions: Alabama
AL01
AL02
AL03
AL04
AL05
AL06
AL07
AL08
AL09
AL10
AL11
AL12
20 0 20 40
Miles
N

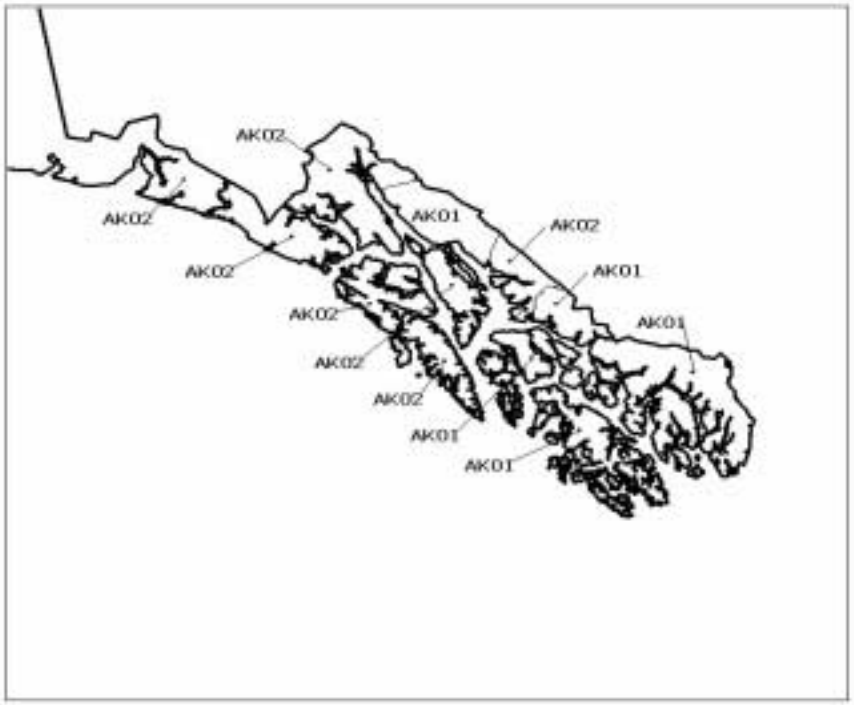

1999 NHSDA Field Interviewer Regions: Alaska
AK04
AK05
AK04
AK06
AK07
AK03
AK02
AK04
AK03
AK03*
AK02
AK03
AK03
100 0 100 200
Miles
N

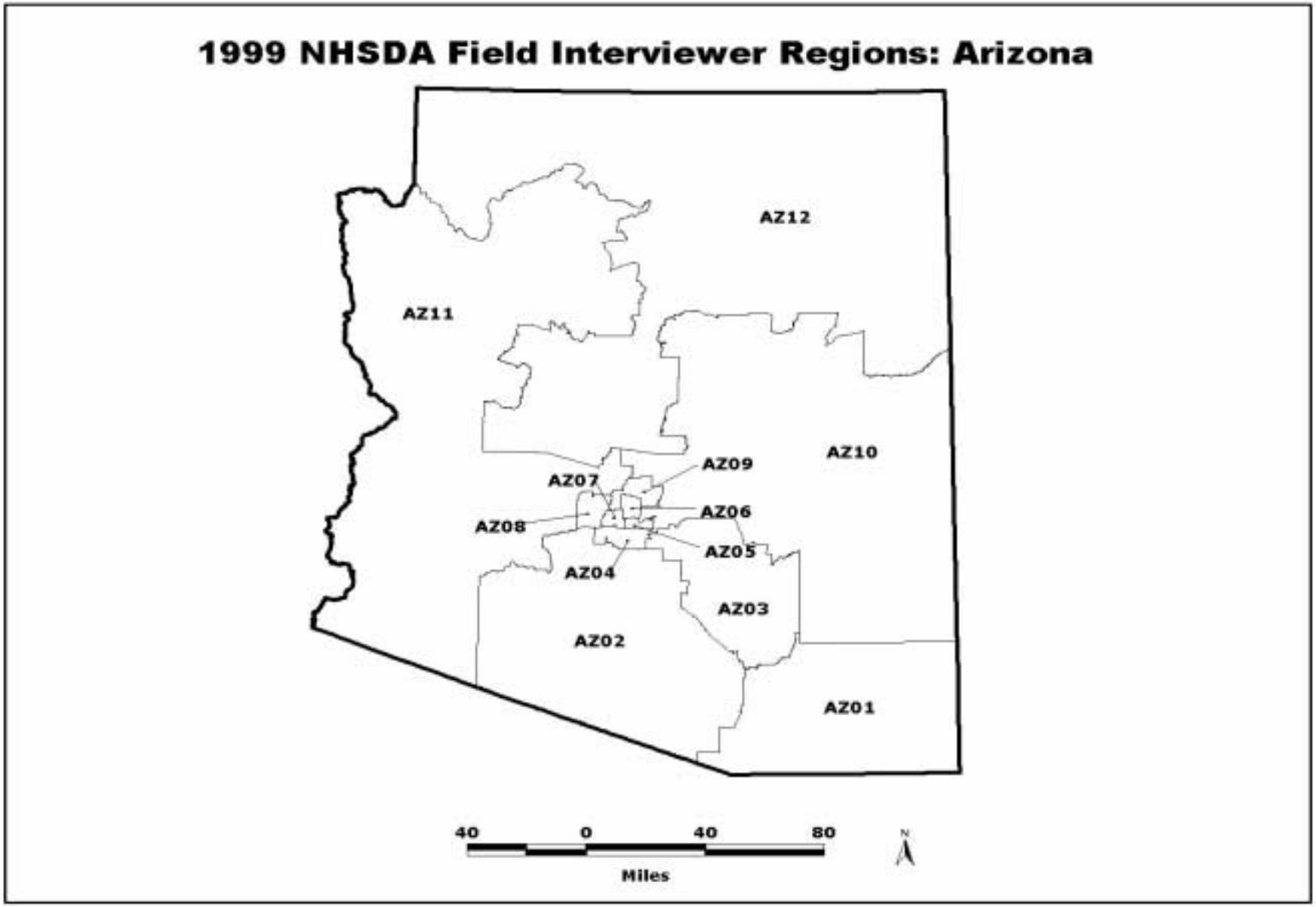
1999 NHSDA Field Interviewer Regions: Alaska Insets

Anchorage Area



Alaska Panhandle

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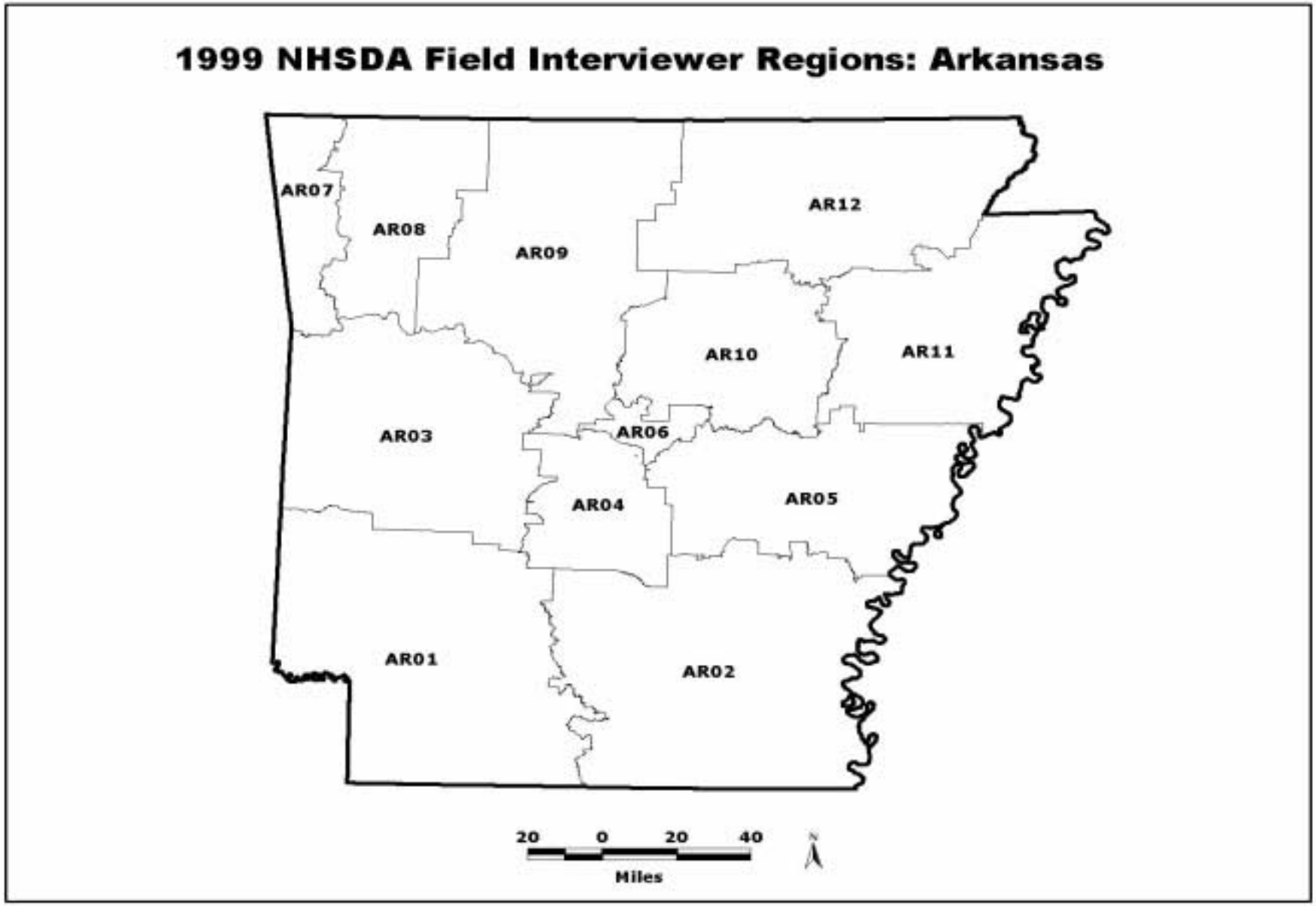
AZ12
AZ11
AZ10
AZ09
AZ07
AZ06
AZ08
AZ05
AZ04
AZ03
AZ02
AZ01
40
0
40
80
Miles
N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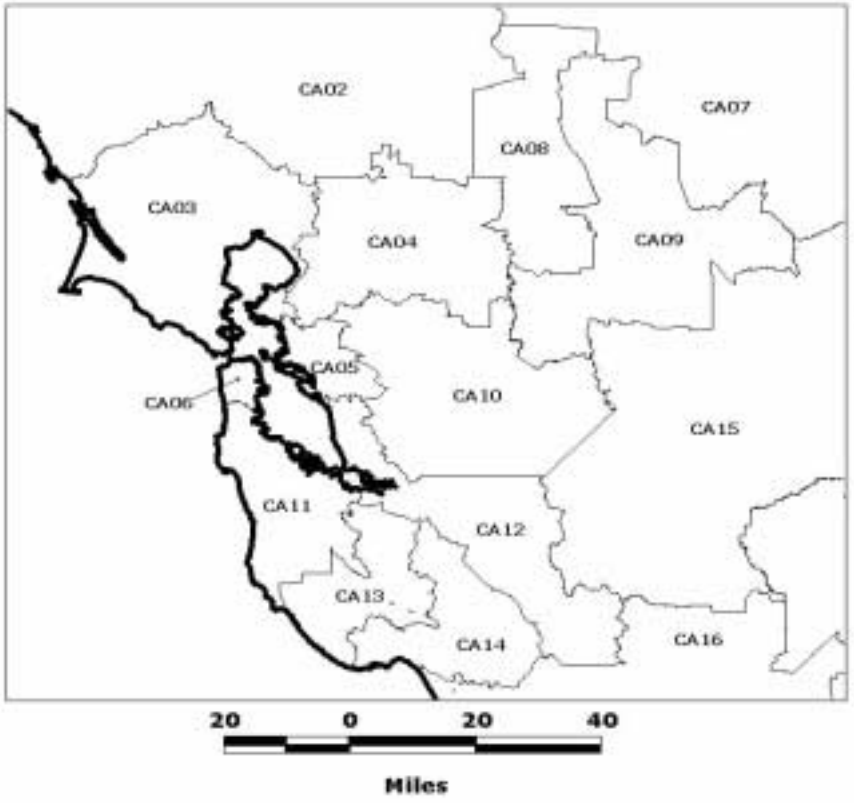
AR07
AR08
AR09
AR12
AR10
AR11
AR03
AR06
AR04
AR05
AR01
AR02
20 0 20 40
Miles
N

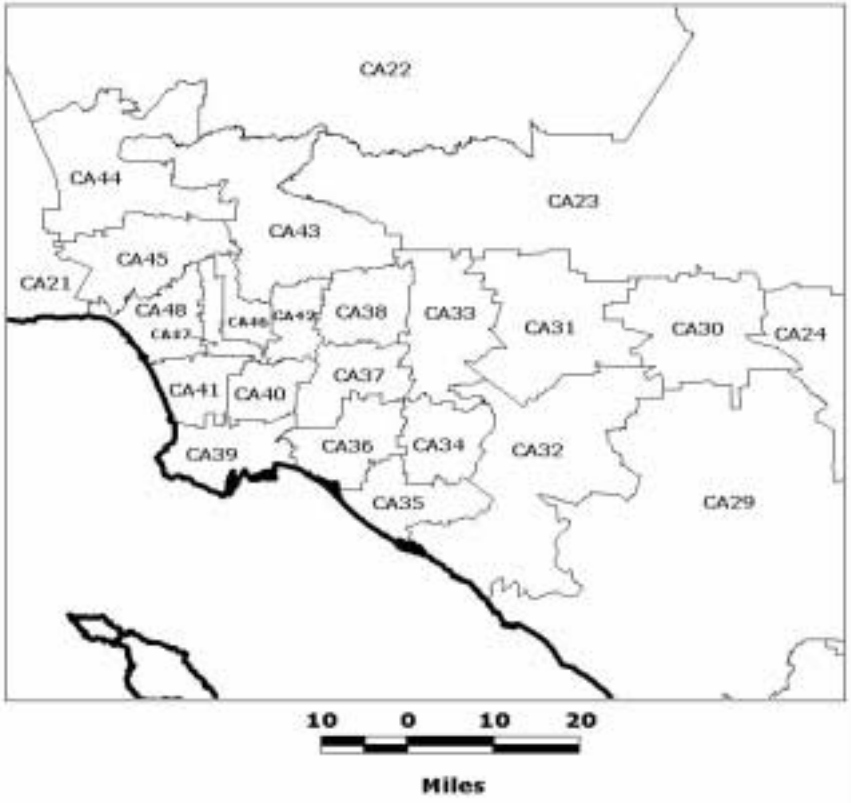

1999 NHSDA Field Interviewer Regions: California
CA01
CA02
CA07
CA15
CA18
CA17
CA16
CA19
CA22
CA23
CA20
CA20
CA20
CA21
CA29
CA24
CA26
CA21
CA28
CA25
CA39
CA27
40 0 40 80
Miles

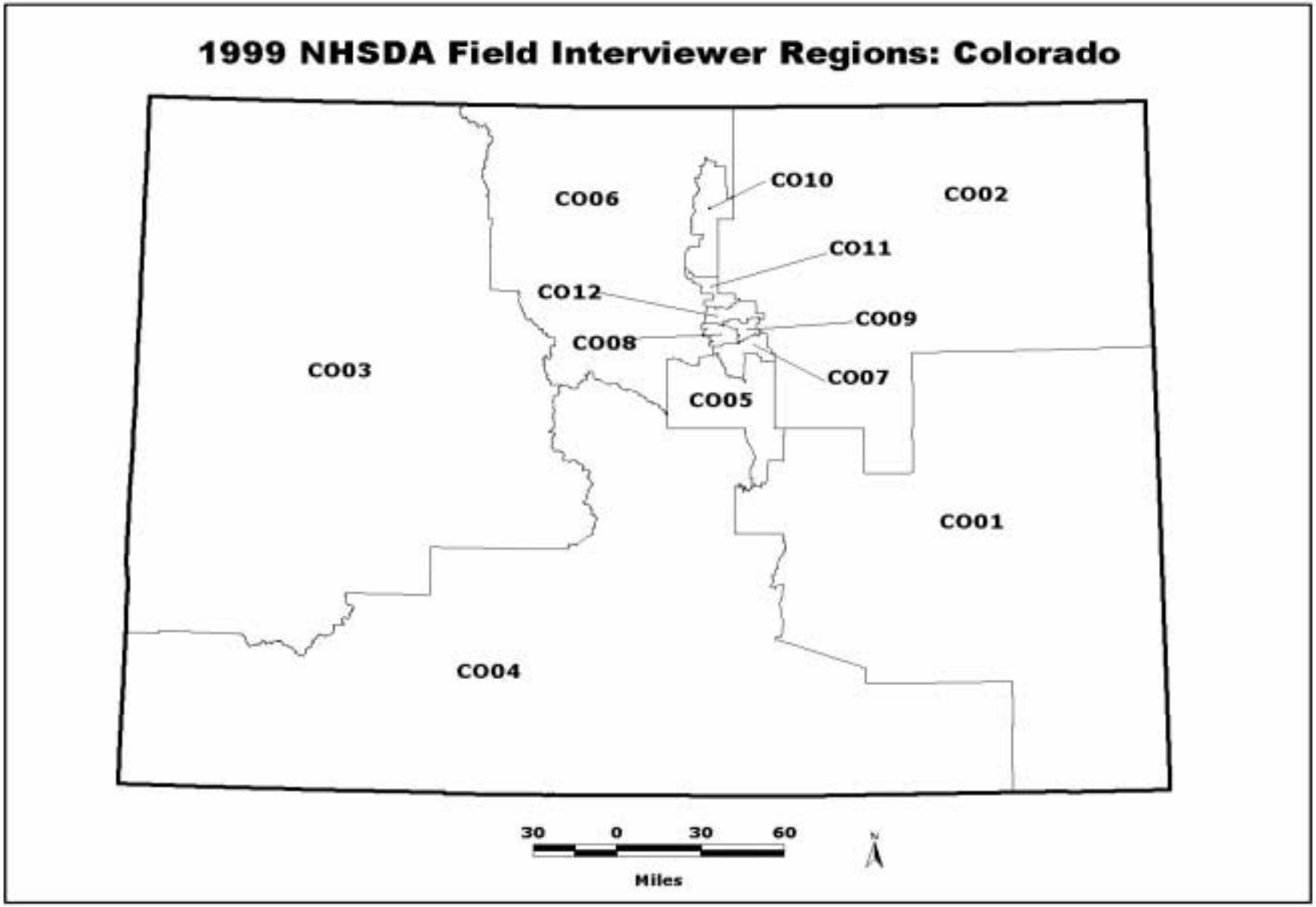
1999 NHSDA Field Interviewer Regions: California Insets

San Francisco Area



Los Angeles Area

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CO10
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Miles
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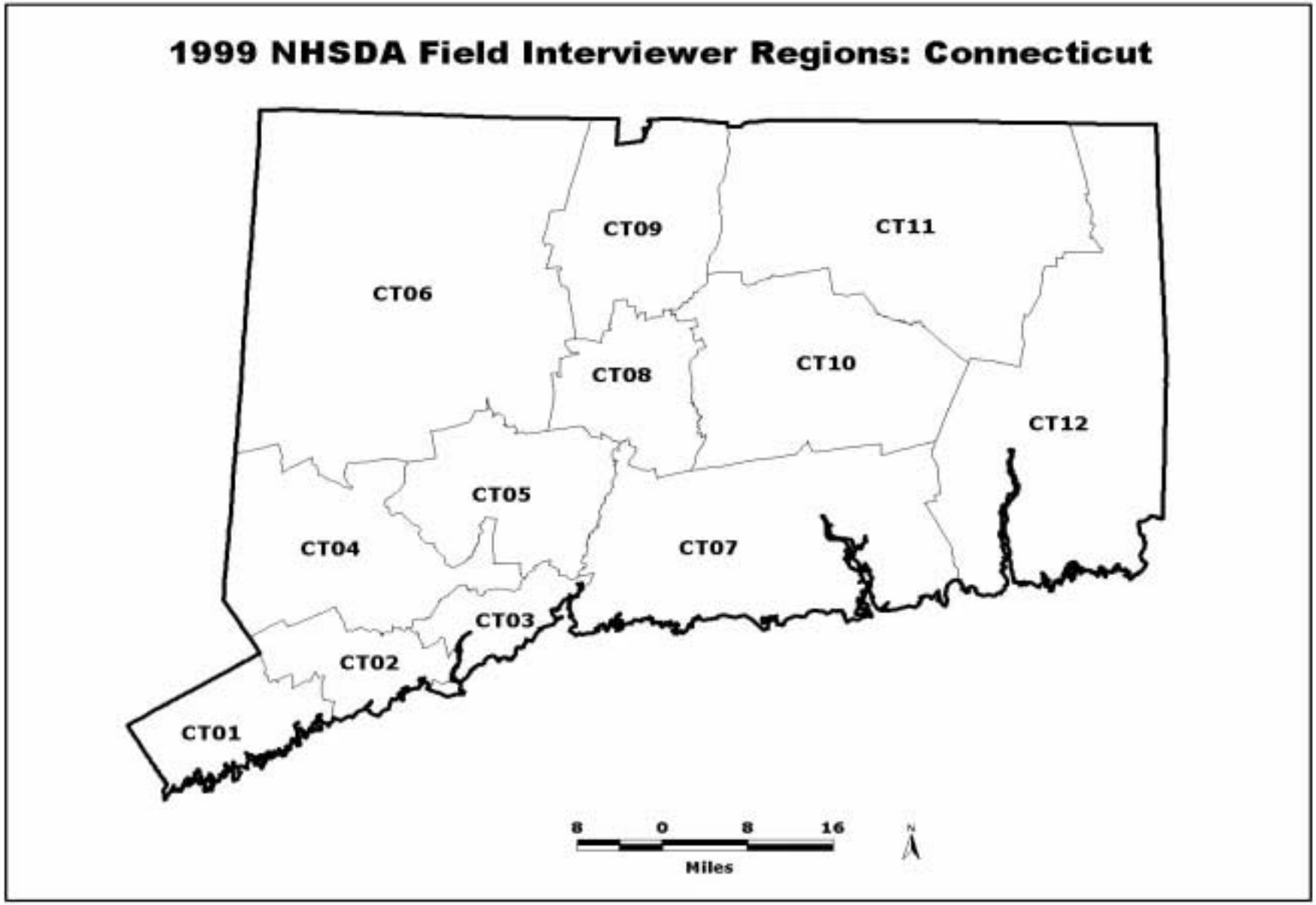
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CT09
CT11
CT06
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CT12
CT05
CT04
CT07
CT03
CT02
CT01
8 0 8 16
Miles
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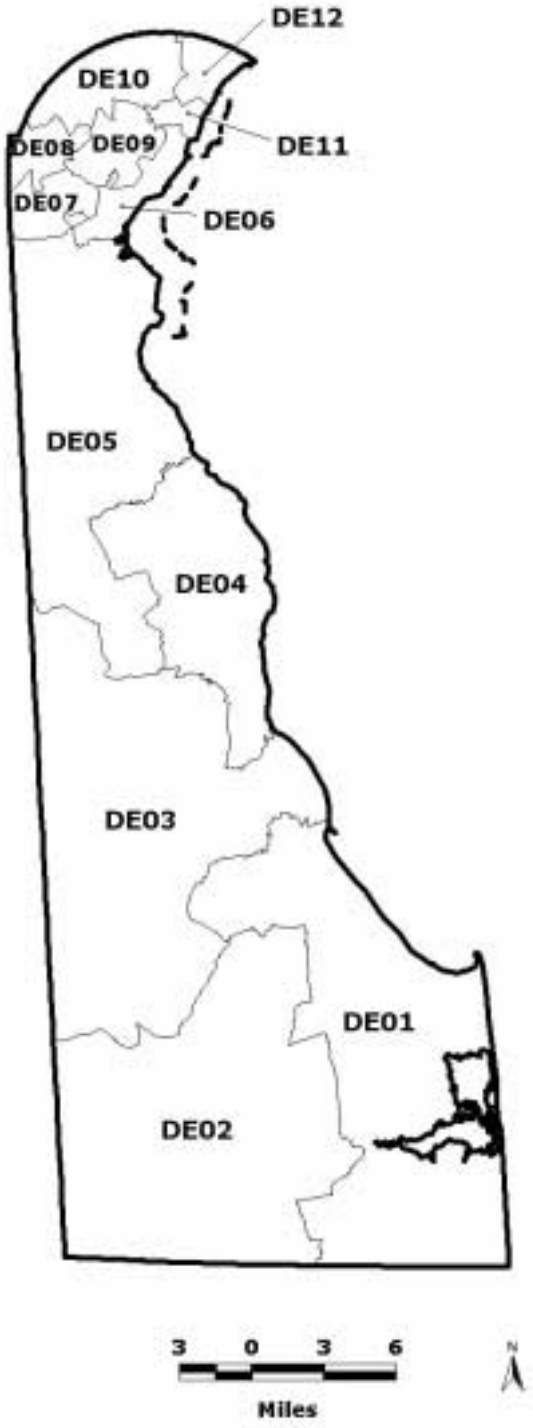


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FL42
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FL37
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FL32
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Miami Area
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FL11
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FL02
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Miles
30 0 30 60
Miles
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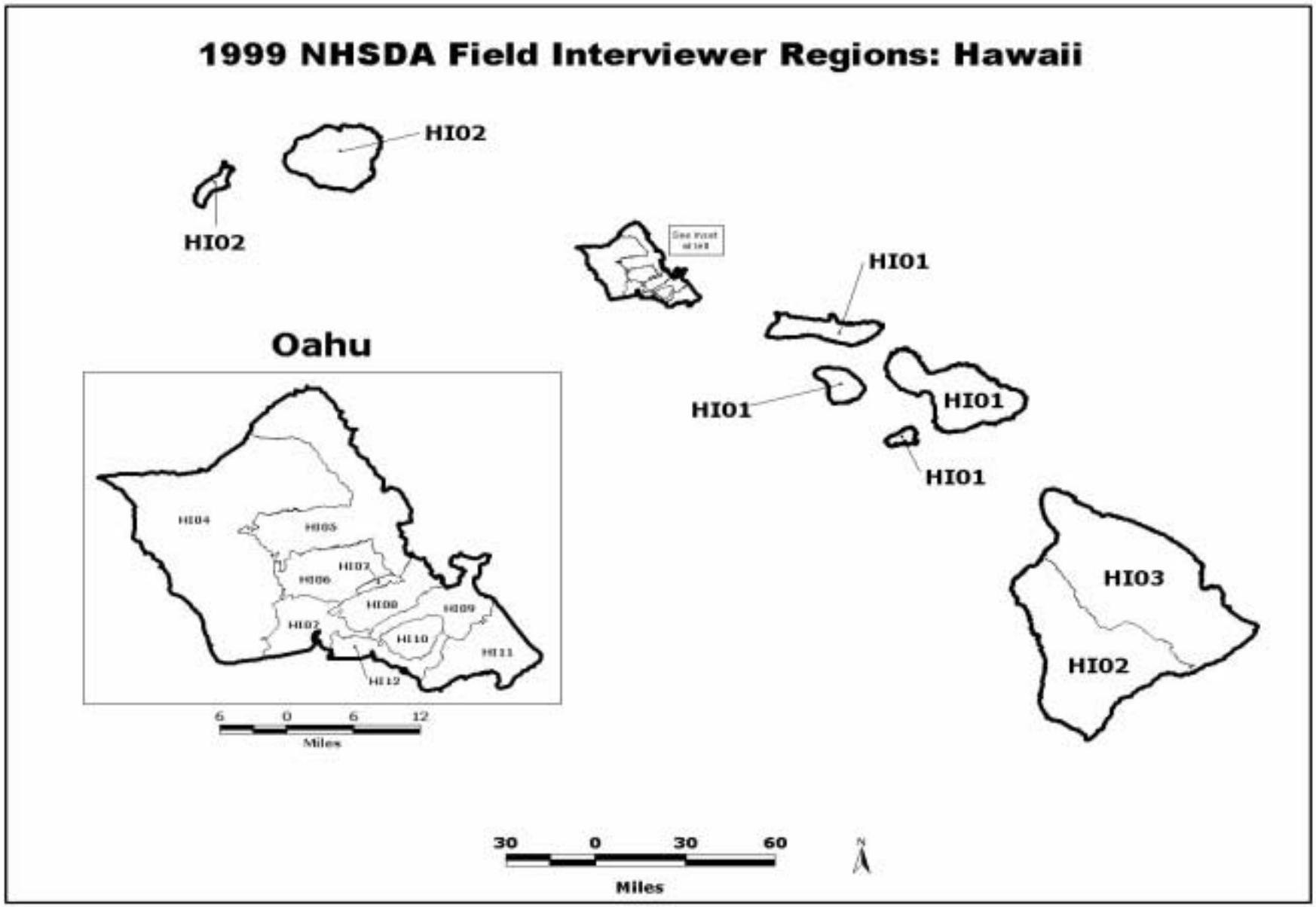
1999 NHSDA Field Interviewer Regions: Georgia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Oahu
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HI07
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HI09
HI02
HI10
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HI12
6 0 6 12
Miles
HI03
HI02
30 0 30 60
Miles
N

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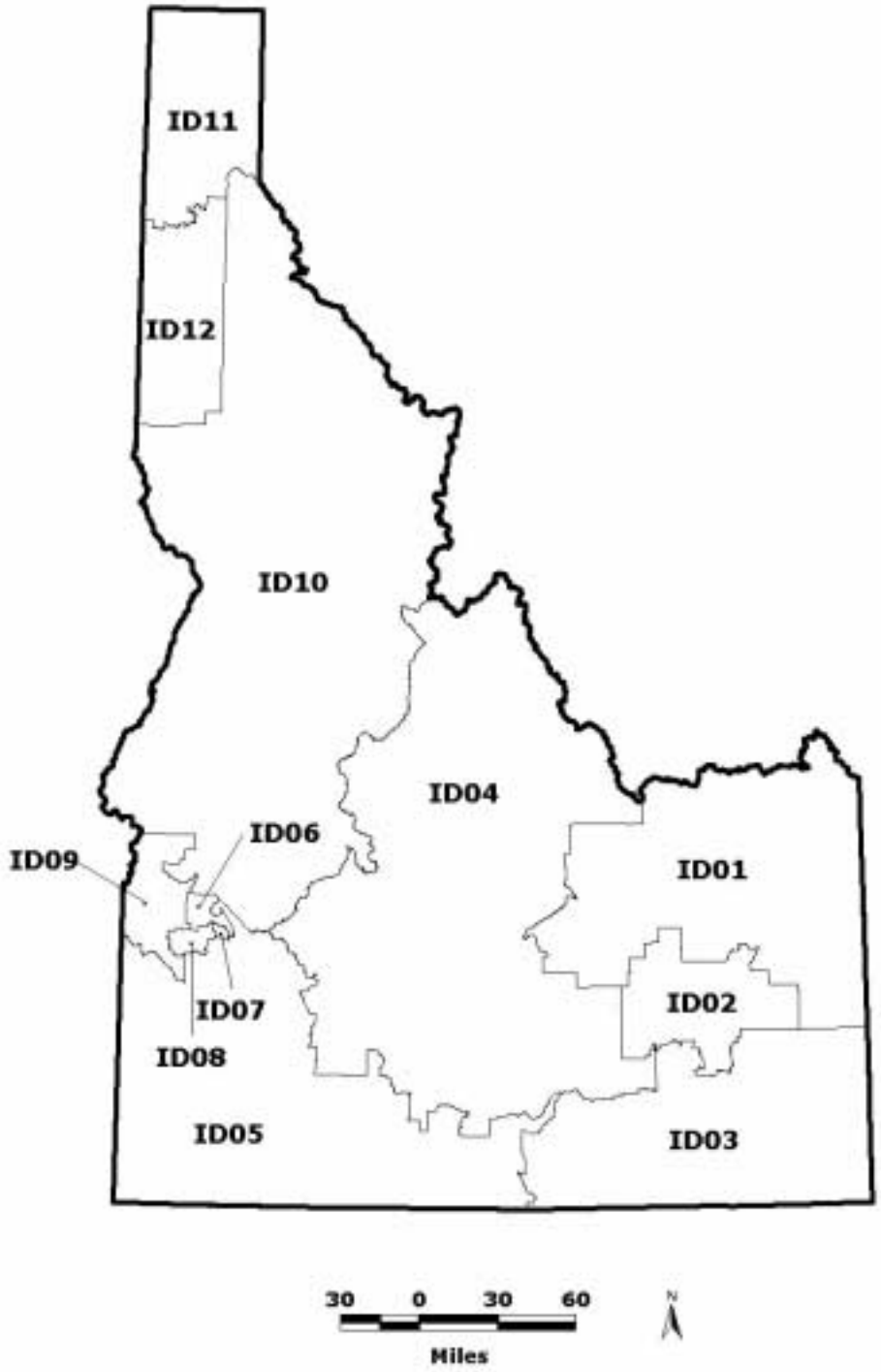

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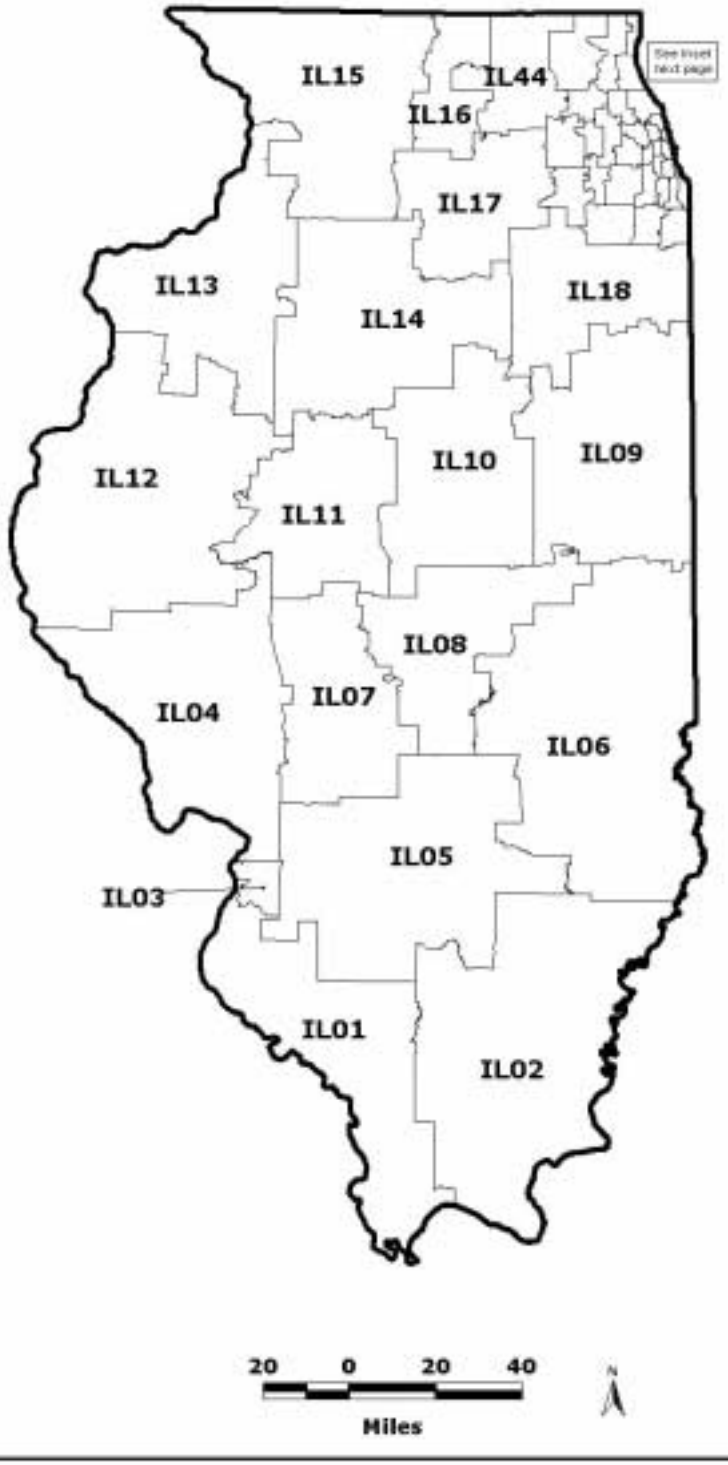

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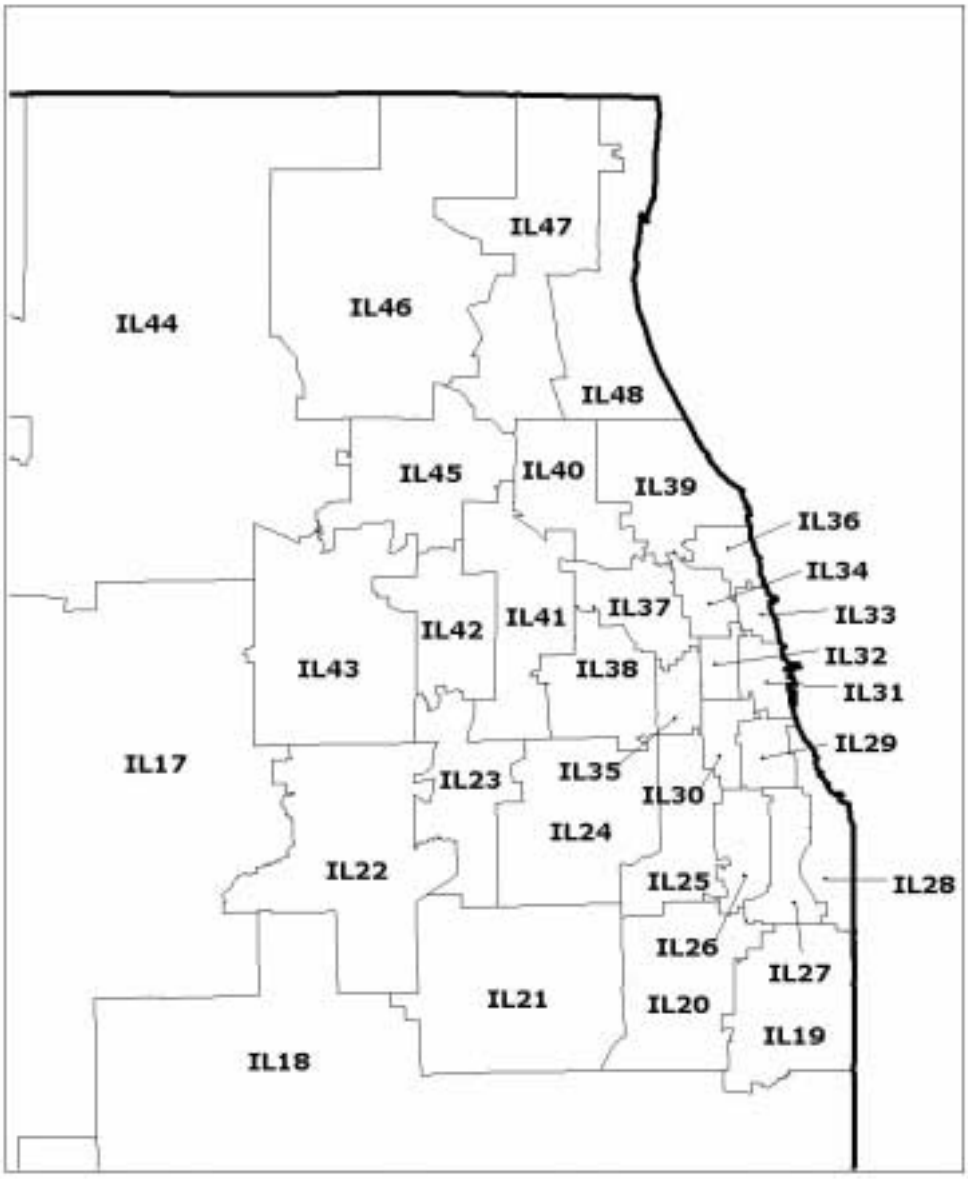

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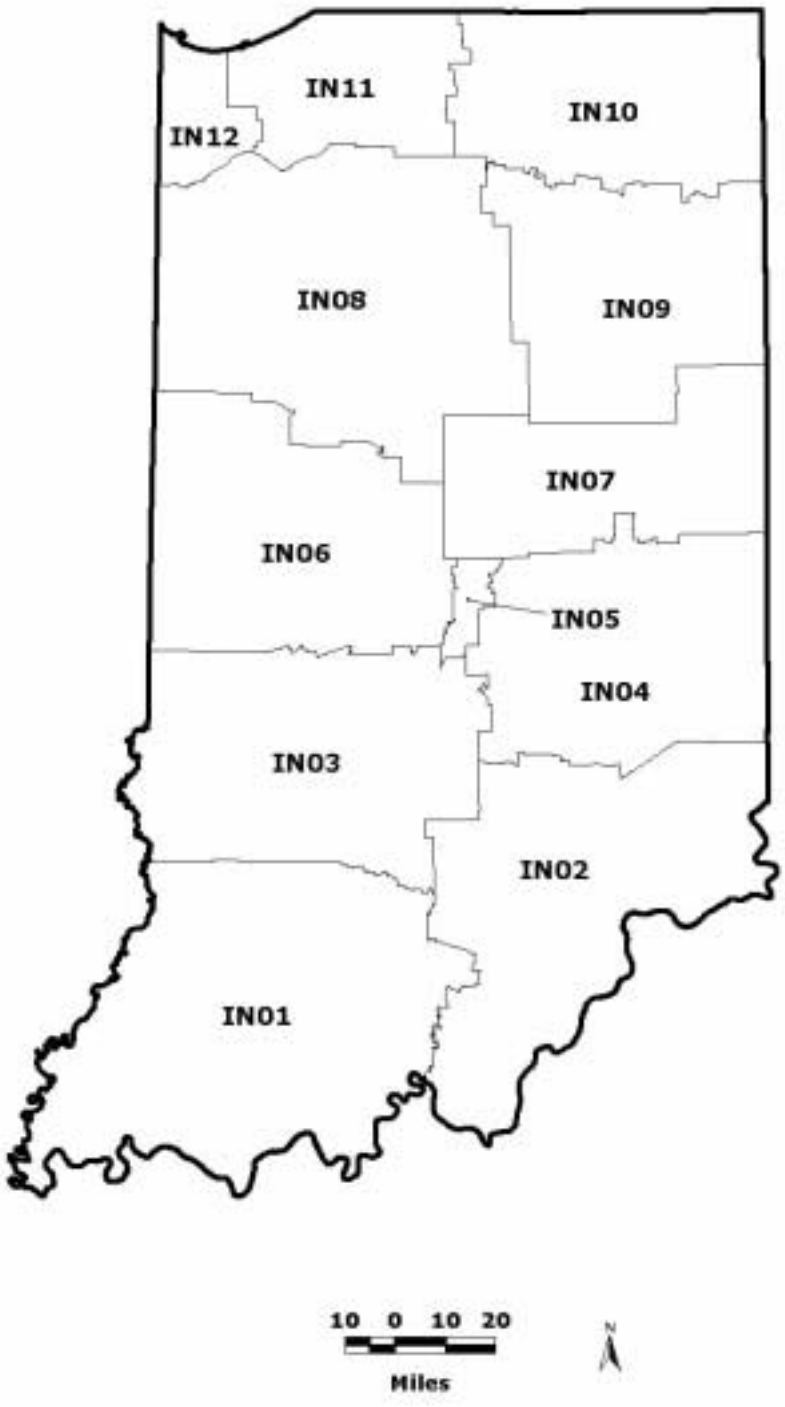

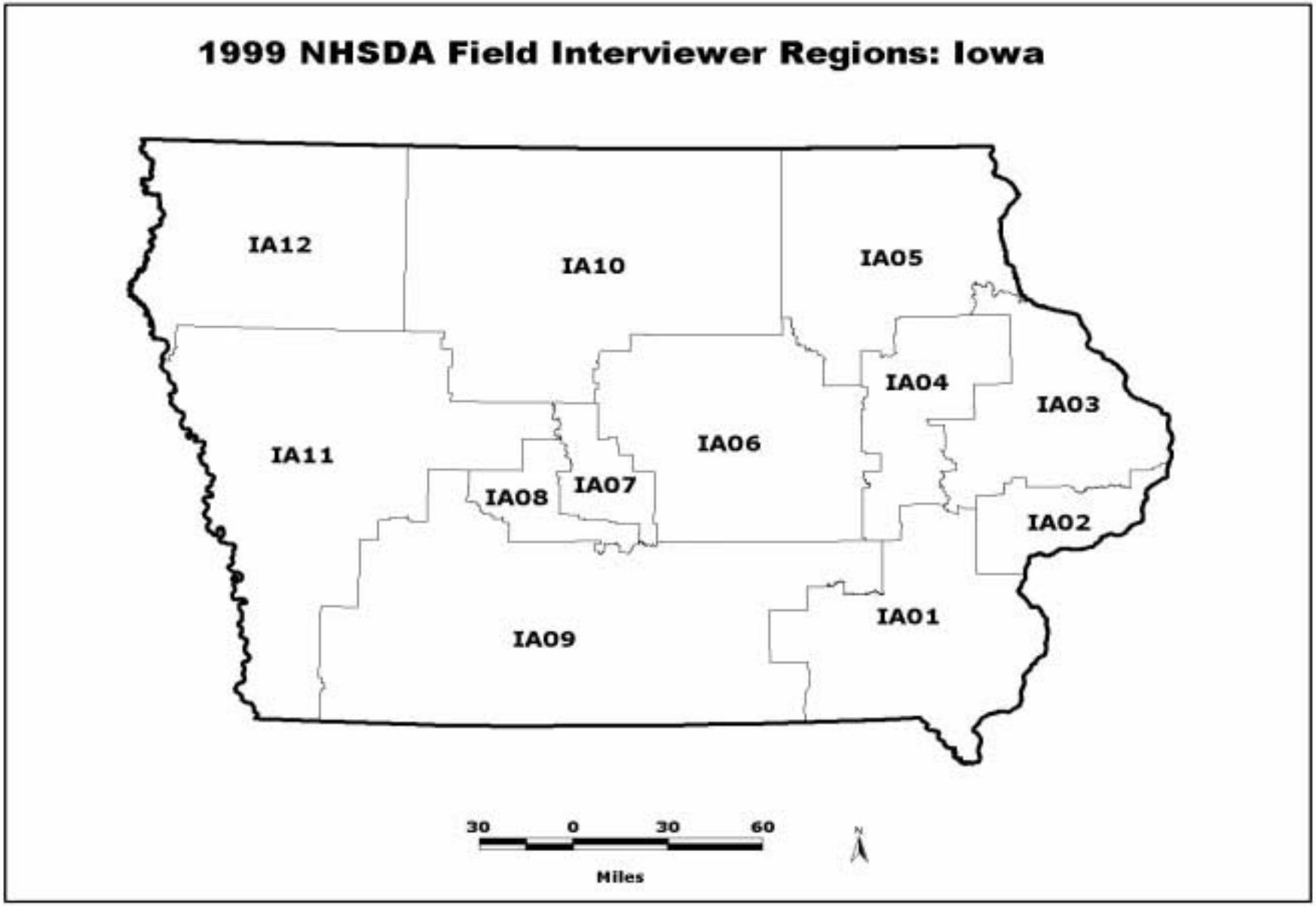
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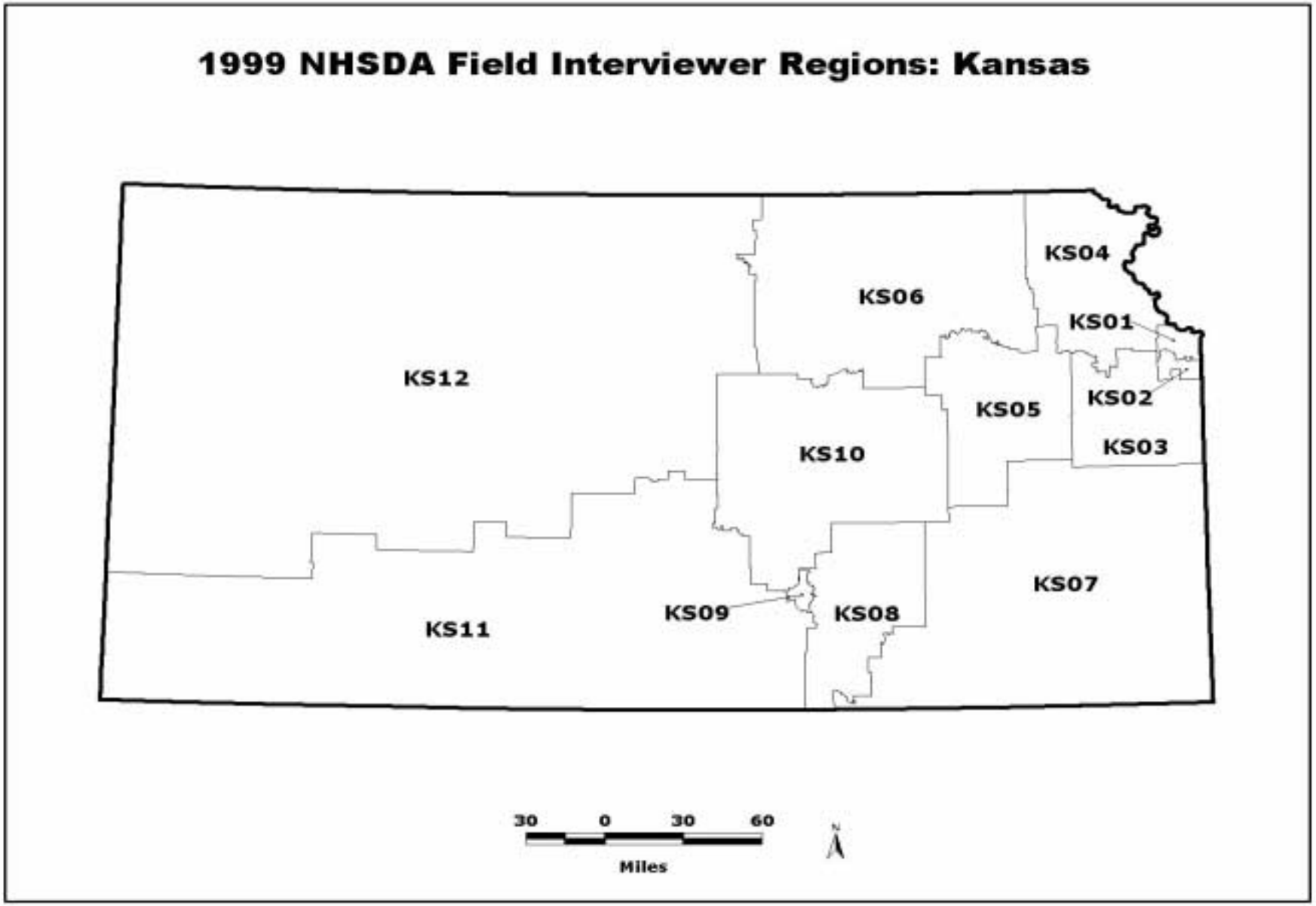
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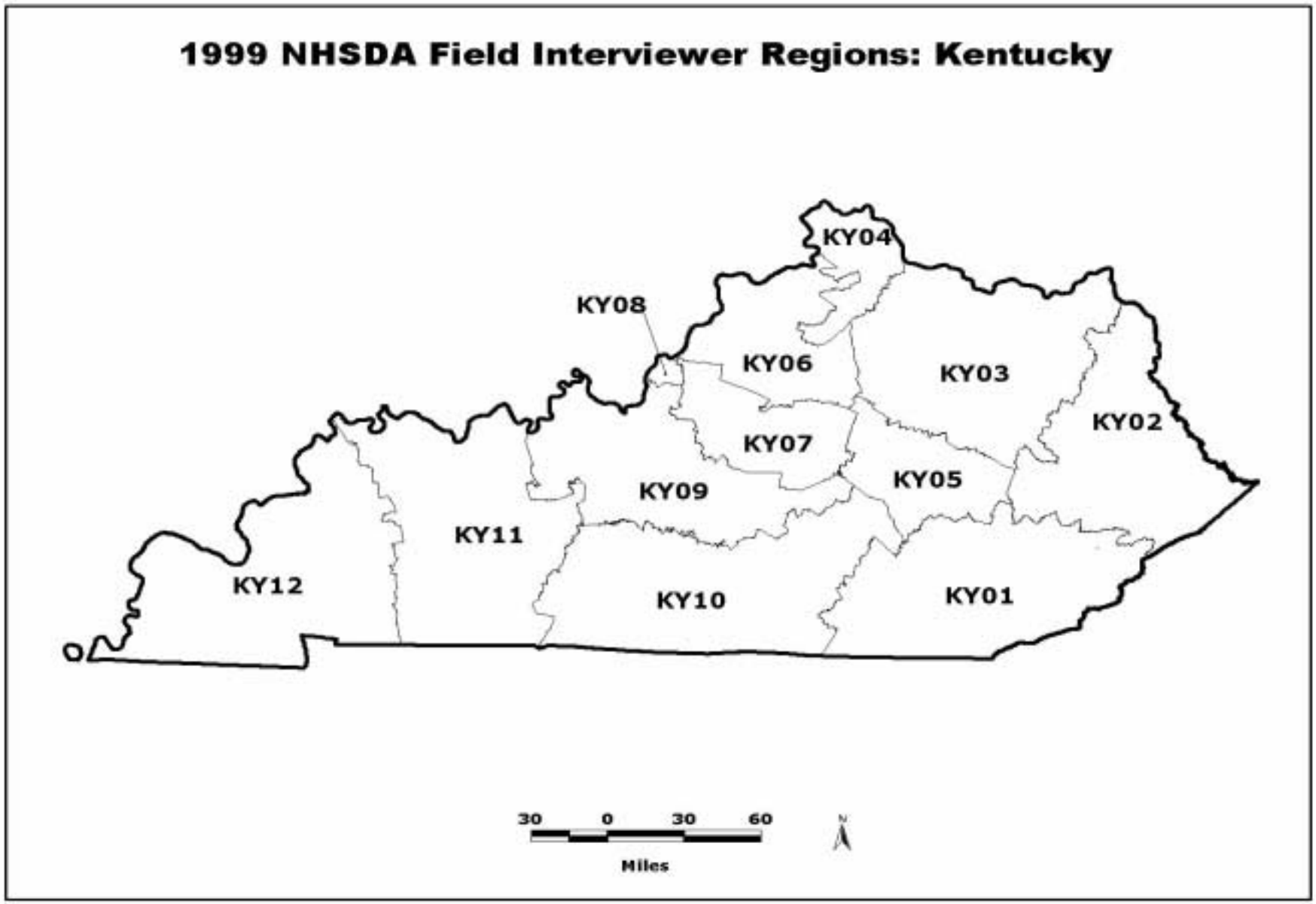
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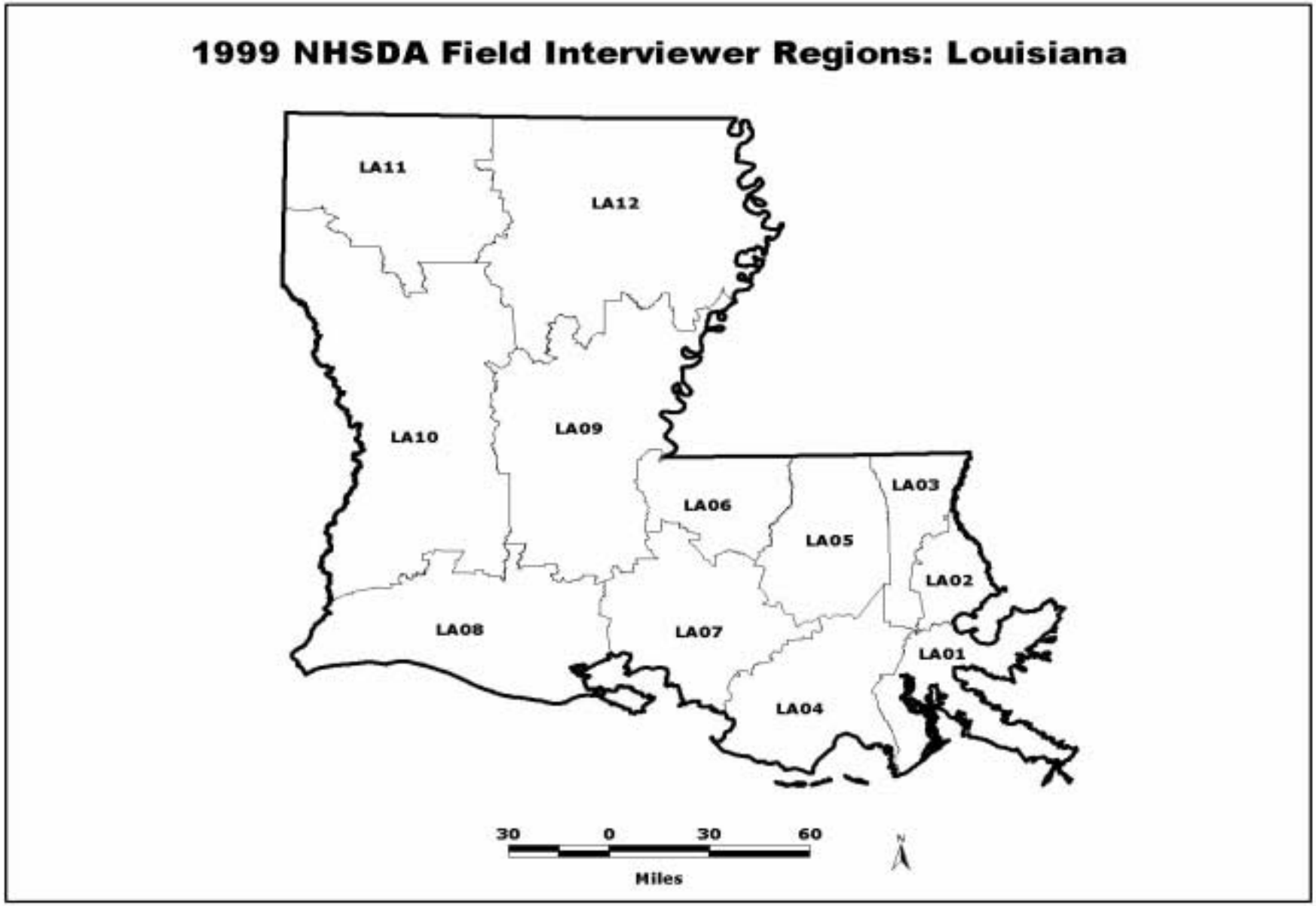
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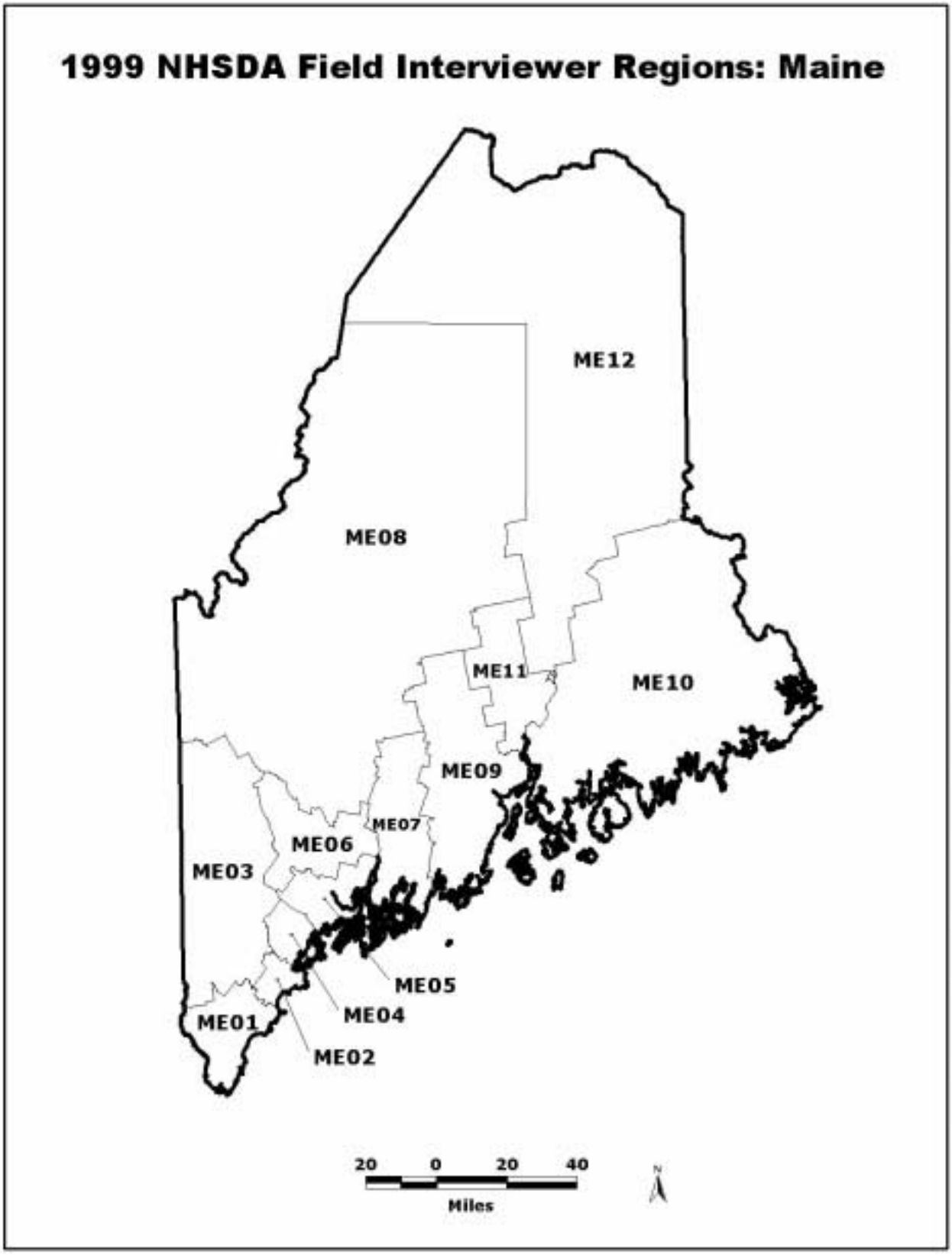
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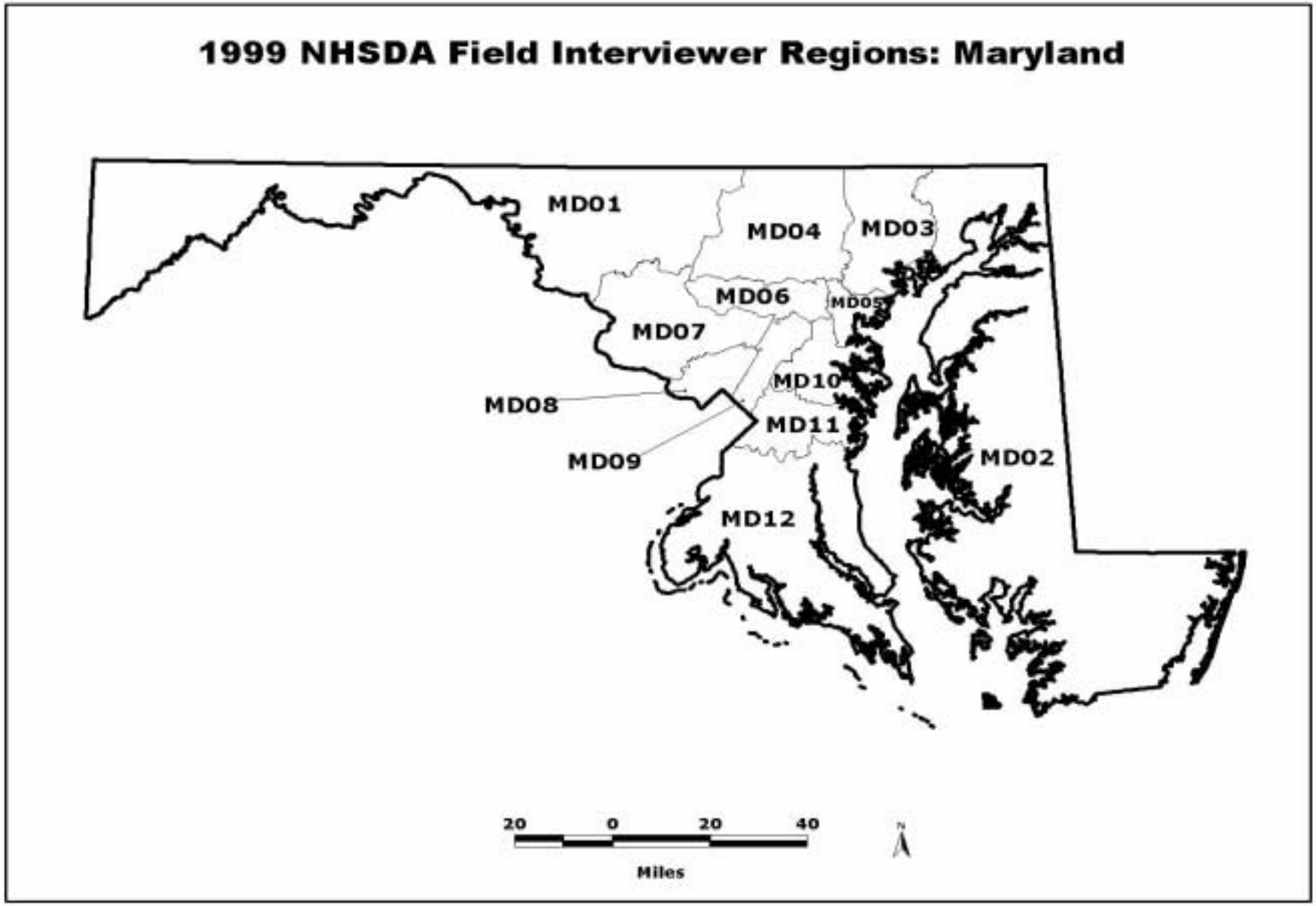
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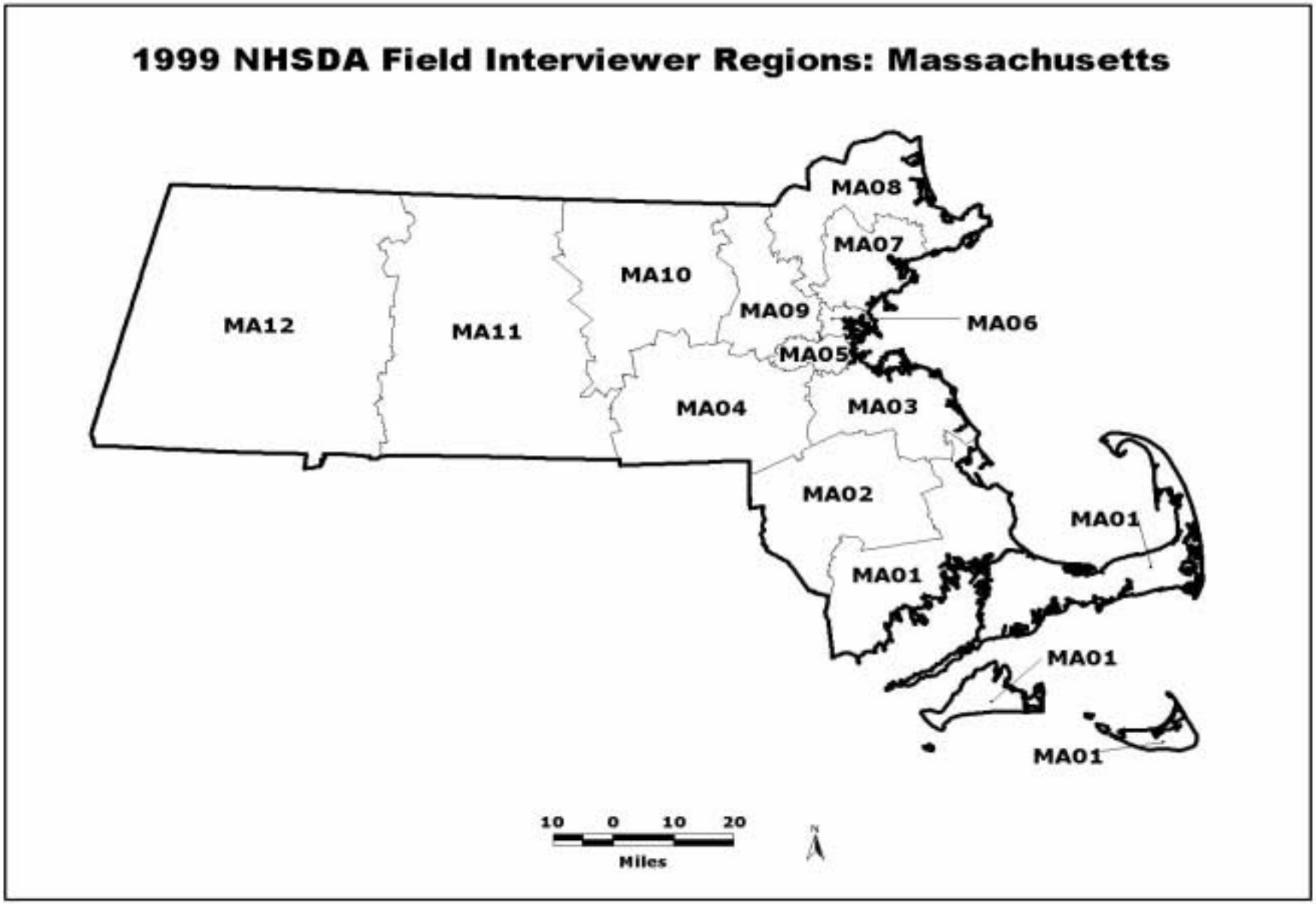
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MA08
MA07
MA10
MA09
MA06
MA12
MA11
MA05
MA04
MA03
MA02
MA01
MA01
MA01
MA01
10 0 10 20
Miles
N


1999 NHSDA Field Interviewer Regions: Michigan
MI01
MI01
MI02
Detroit Area
MI03
MI04
MI05
MI06
MI14
MI15
MI07
MI08
MI13
MI16
MI17
MI18
MI19
MI21
MI20
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MI11
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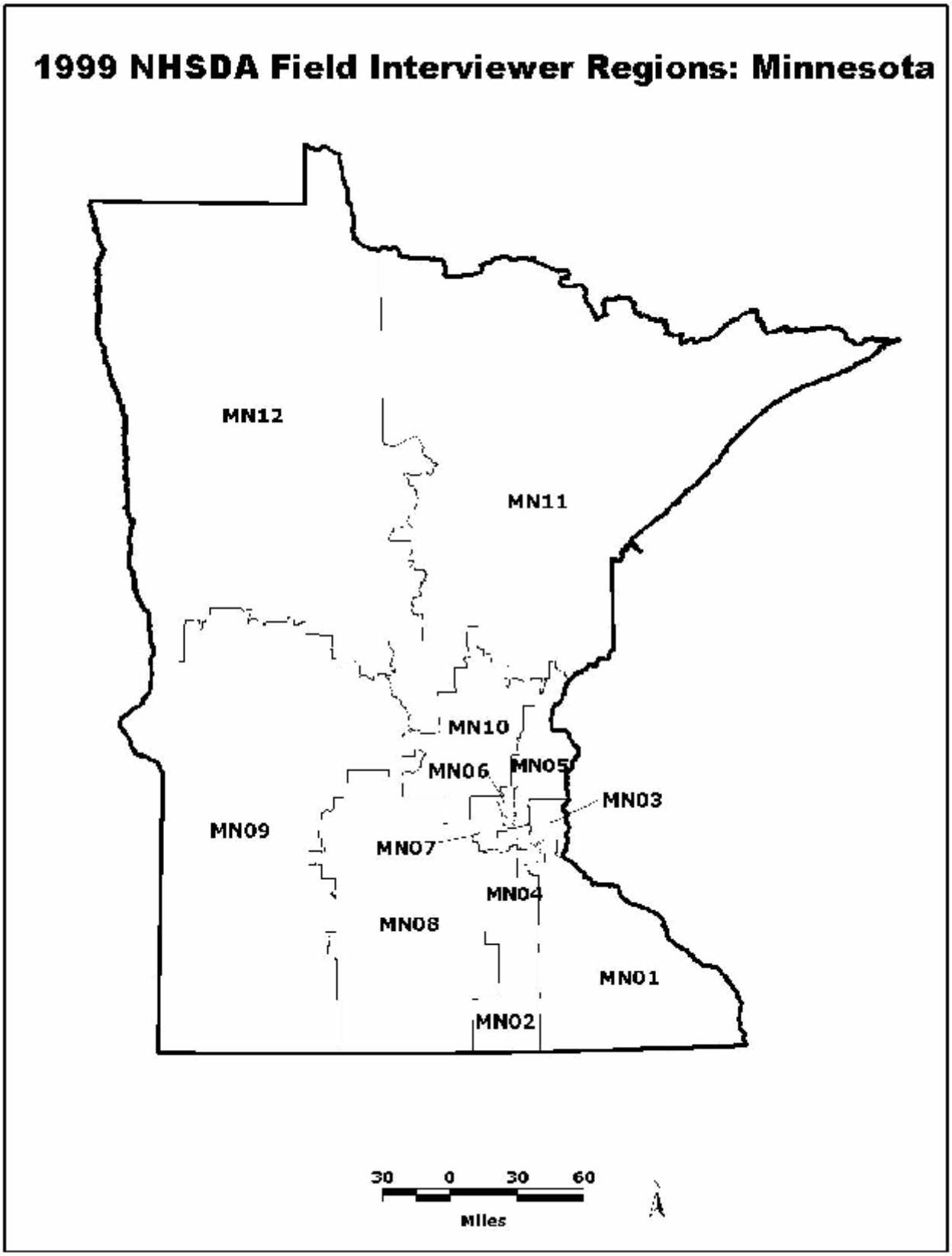
Miles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MN12
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MN06
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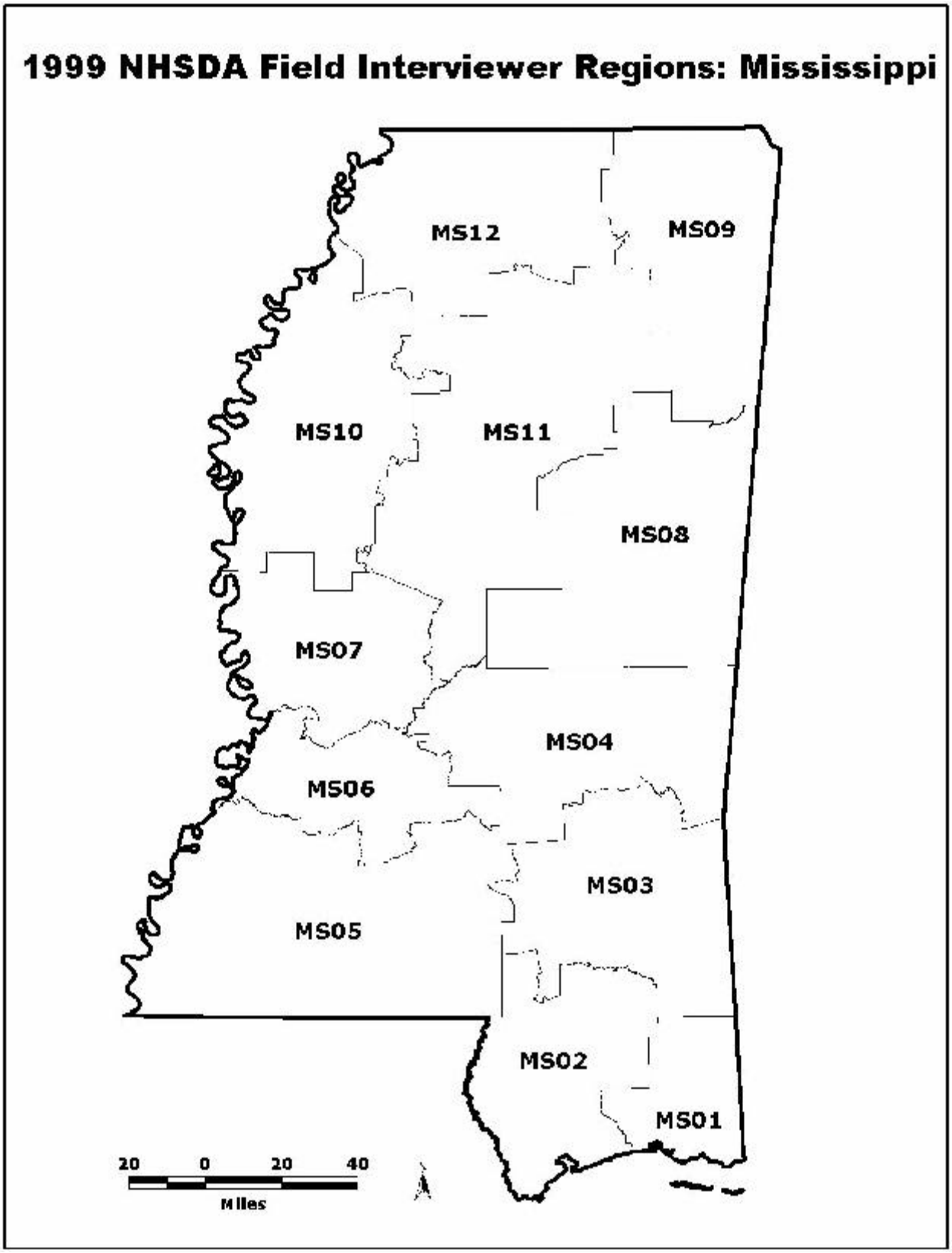
Miles

1999 NHSDA Field Interviewer Regions: Mississippi



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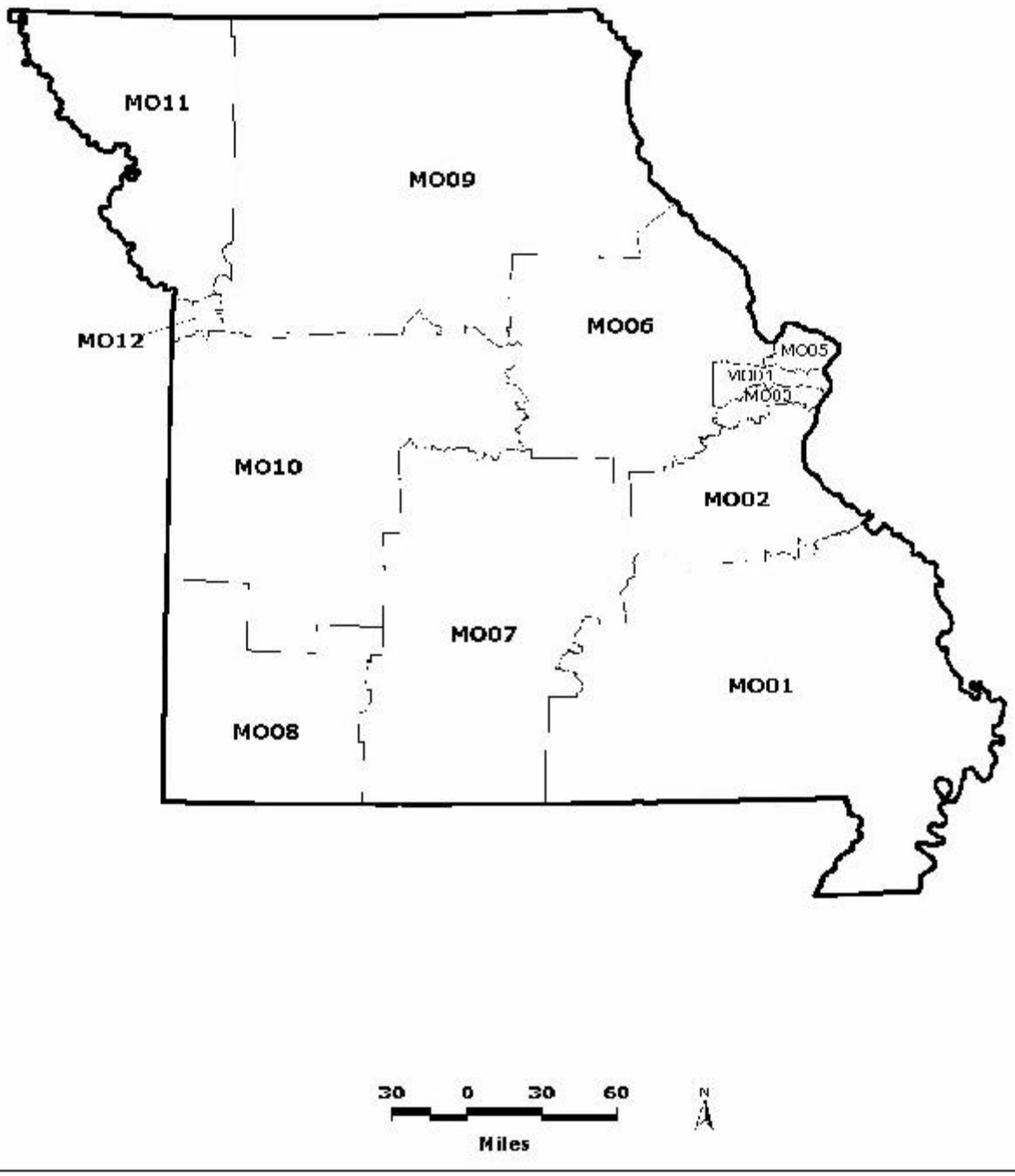

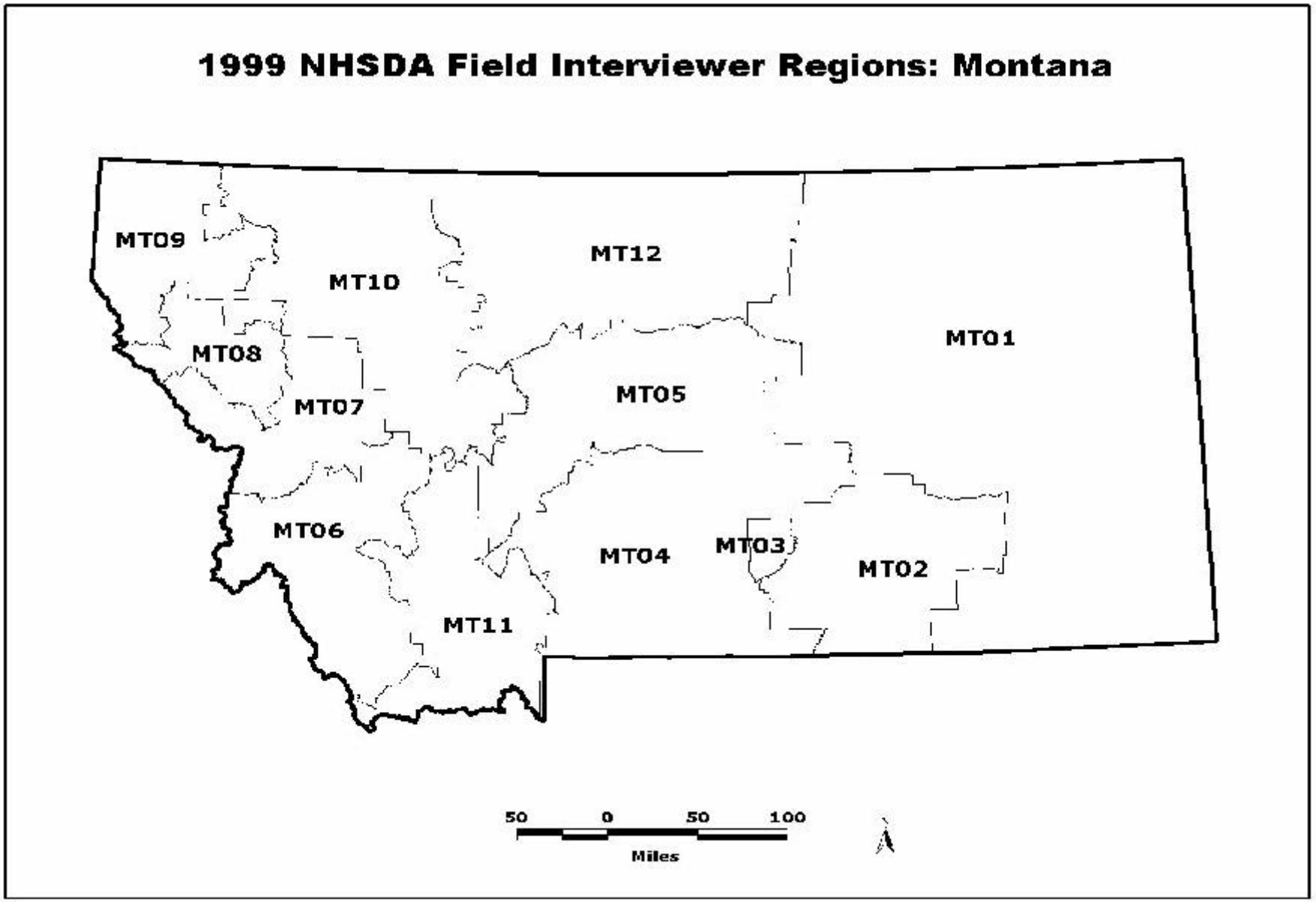
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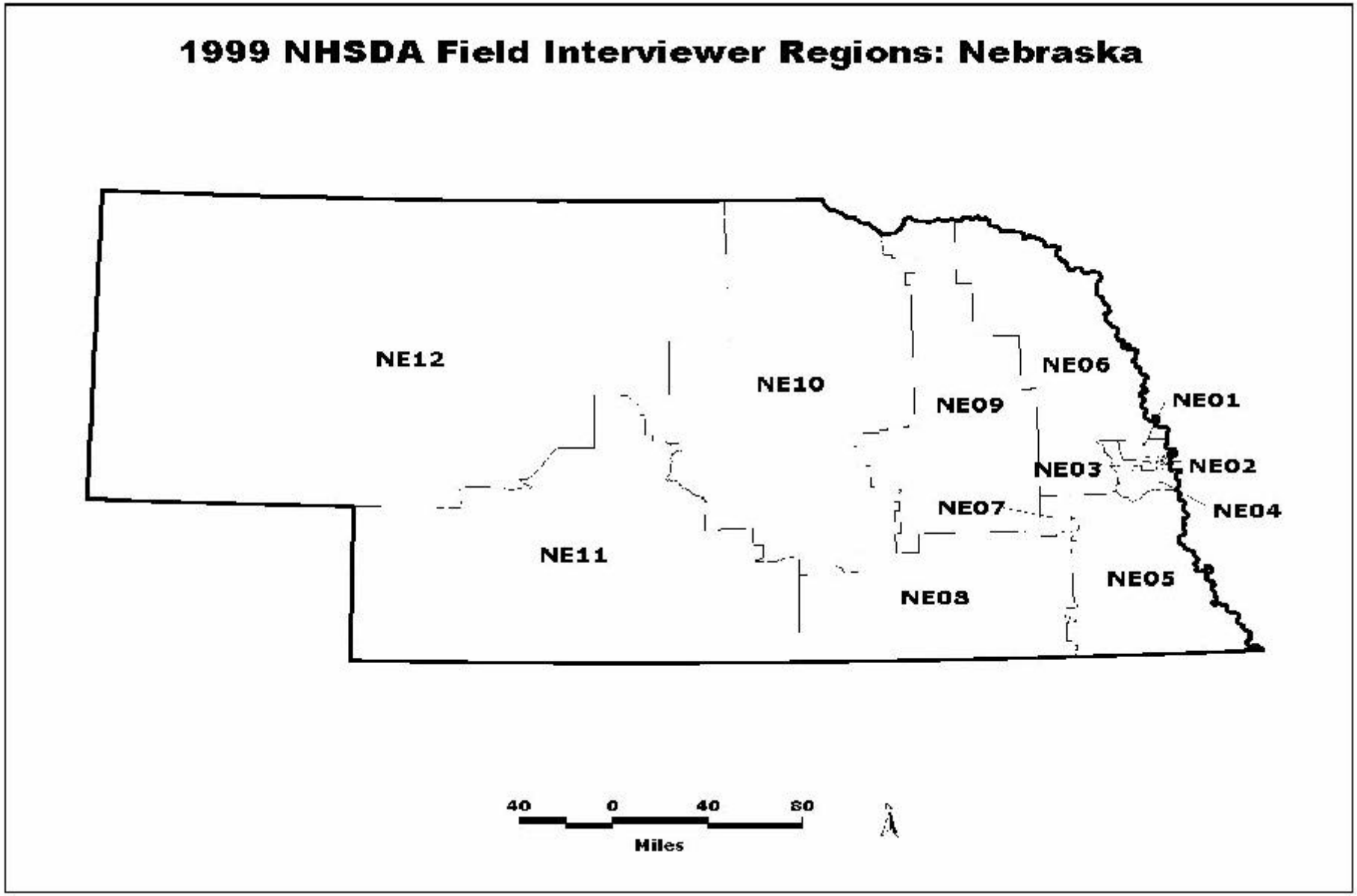
MT09
MT10
MT12
MT01
MT08
MT07
MT05
MT06
MT04
MT03
MT02
MT11
50
0
50
100
Miles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NE12
NE10
NE06
NE09
NE01
NE03
NE02
NE07
NE04
NE11
NE05
NE08
40
0
40
80
Miles
N

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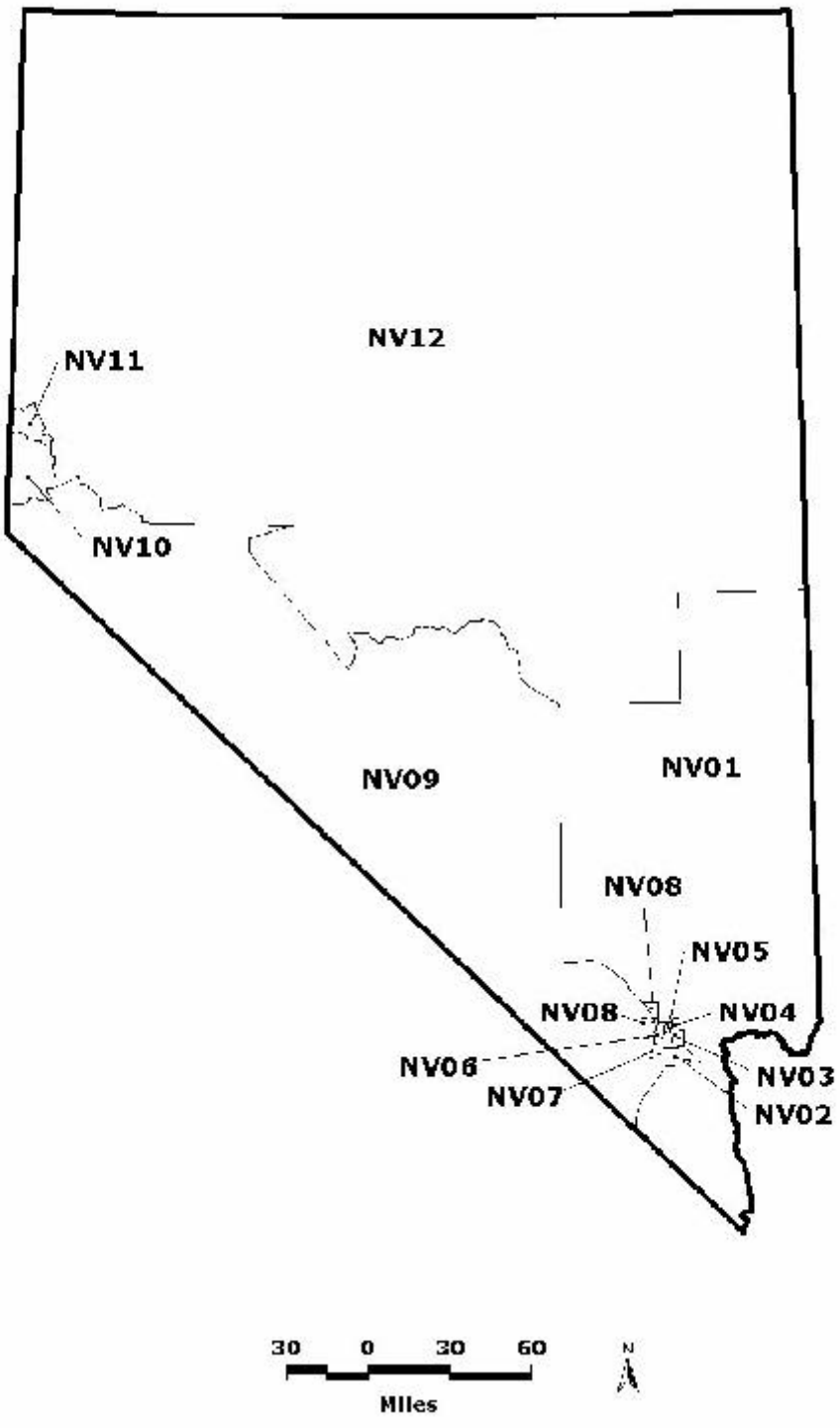
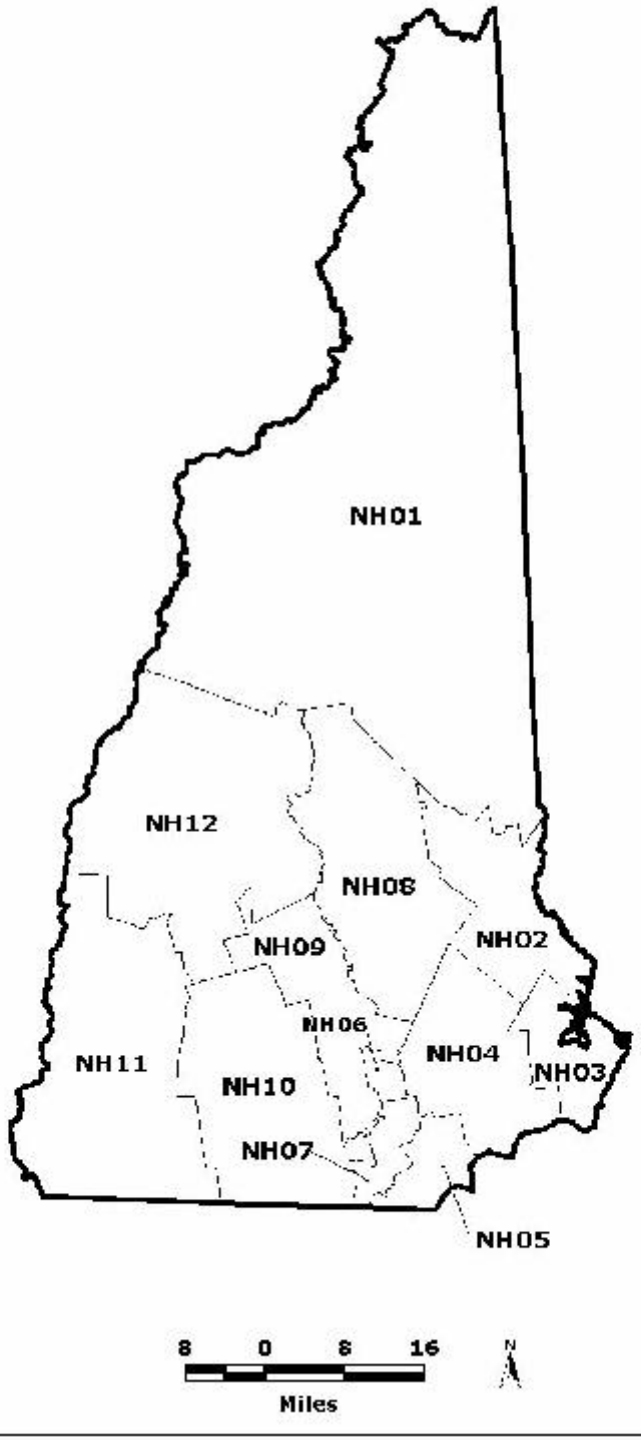


1999 NHSDA Field Interviewer Regions: New Hampshire



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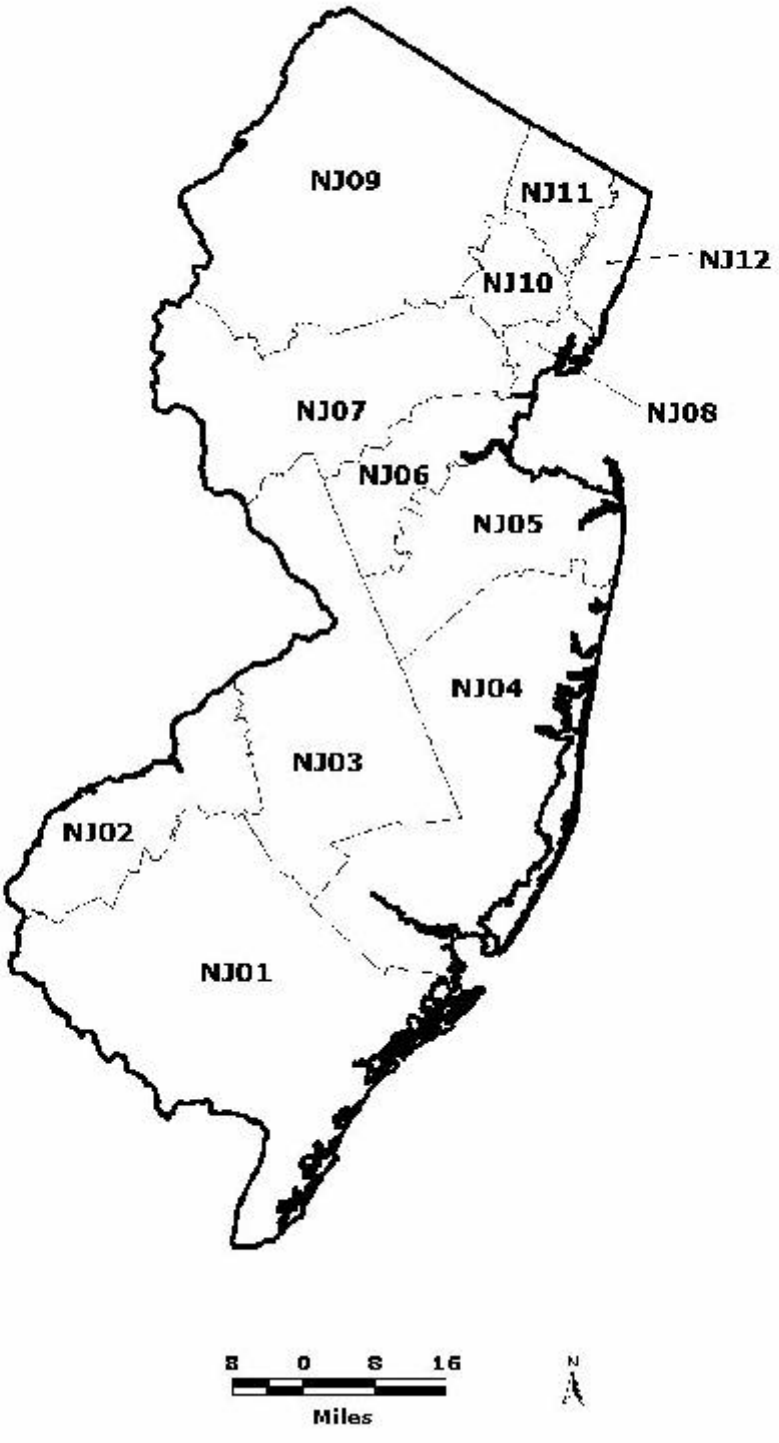
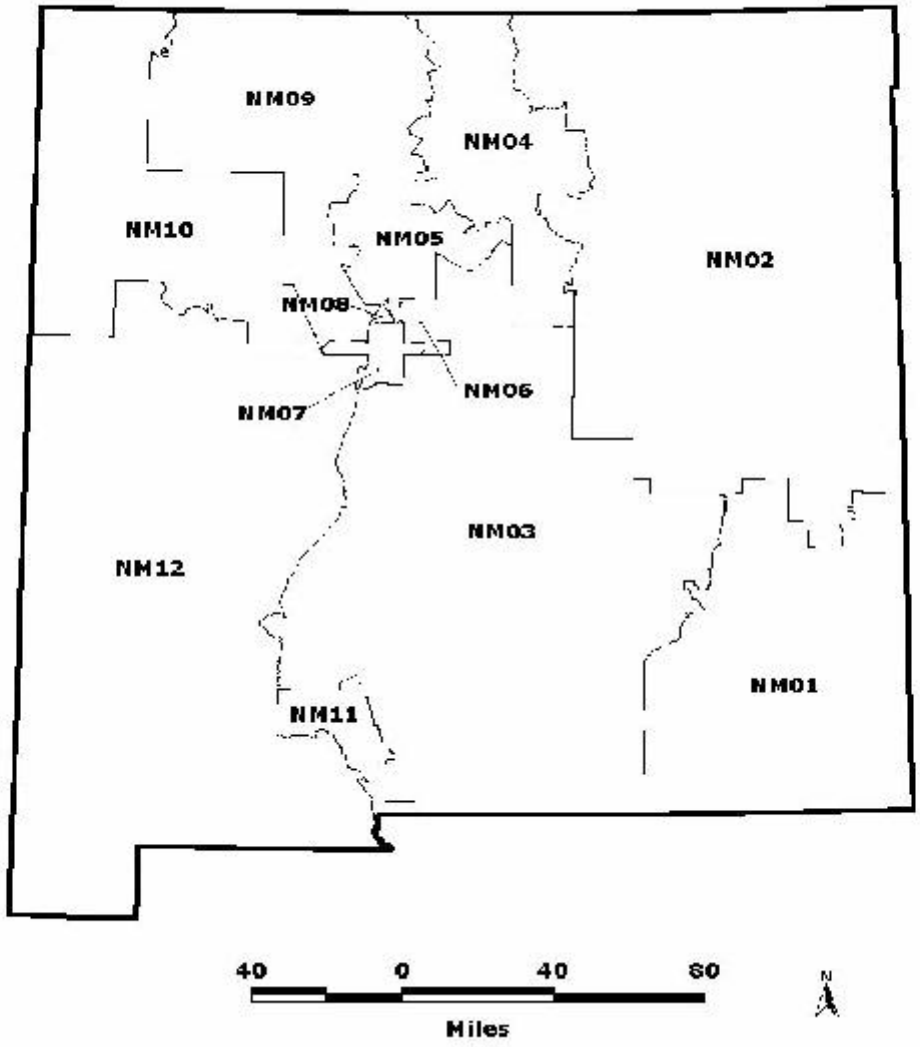
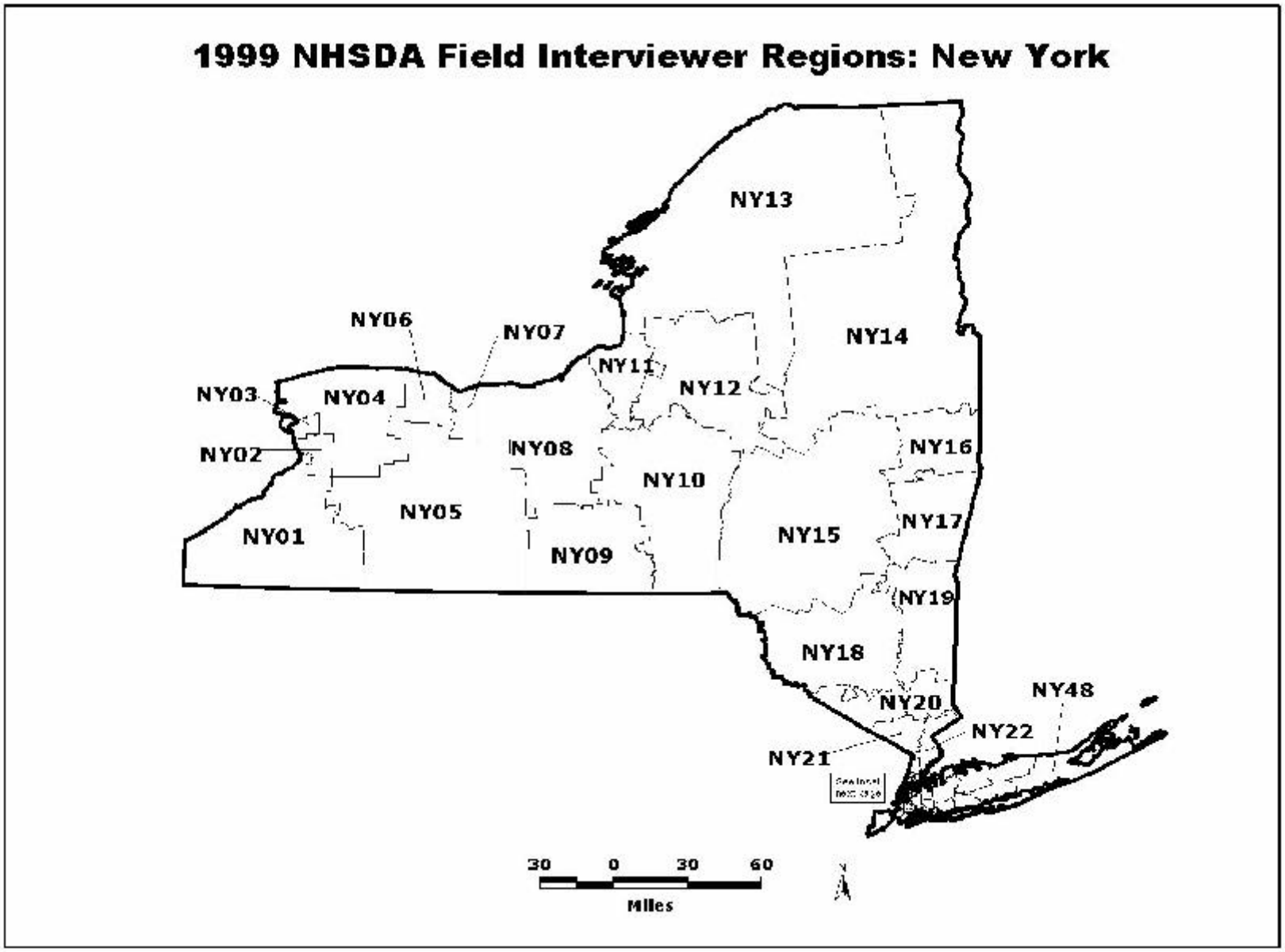


1999 NHSDA Field Interviewer Regions: New Mexico

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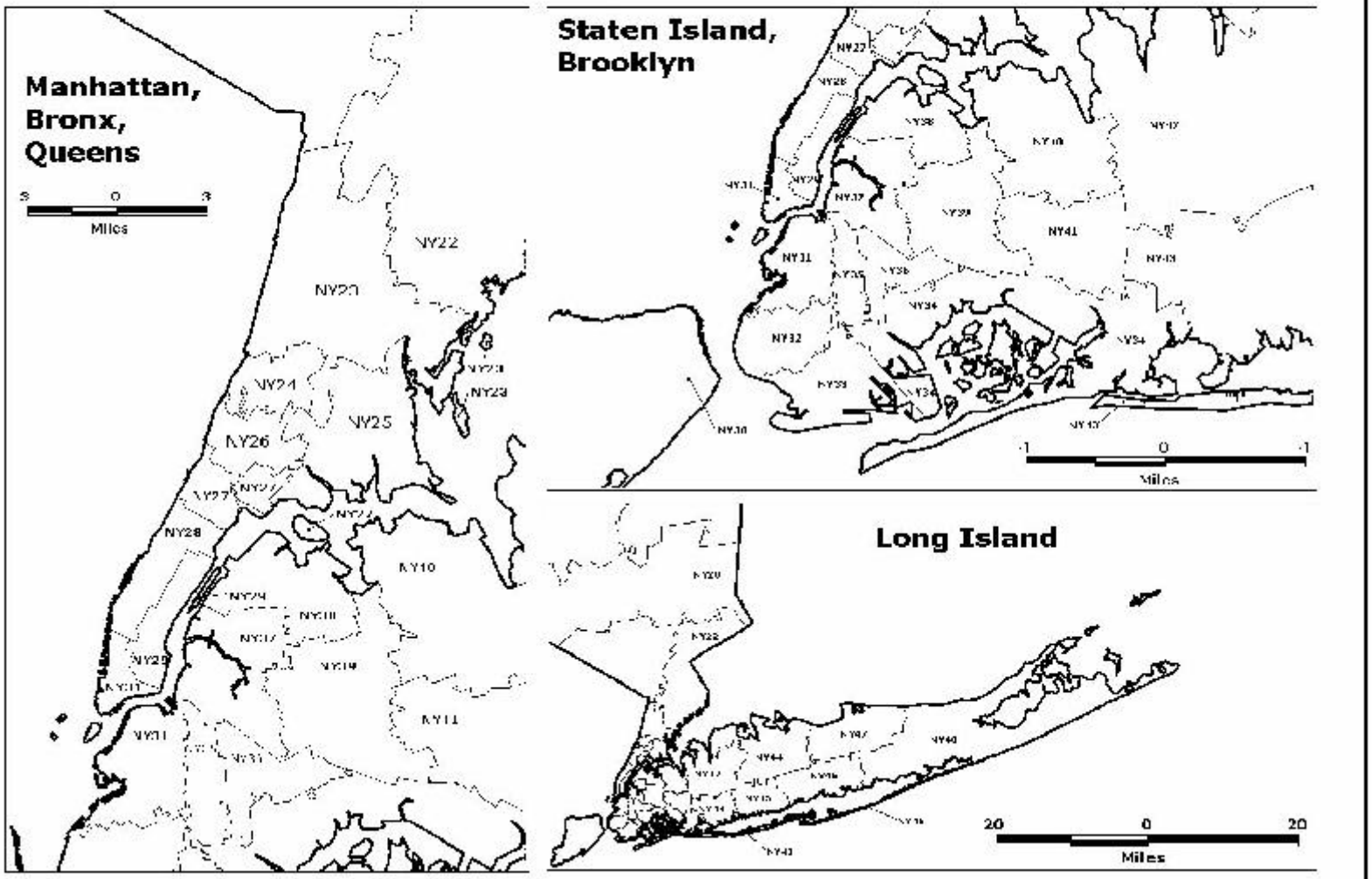
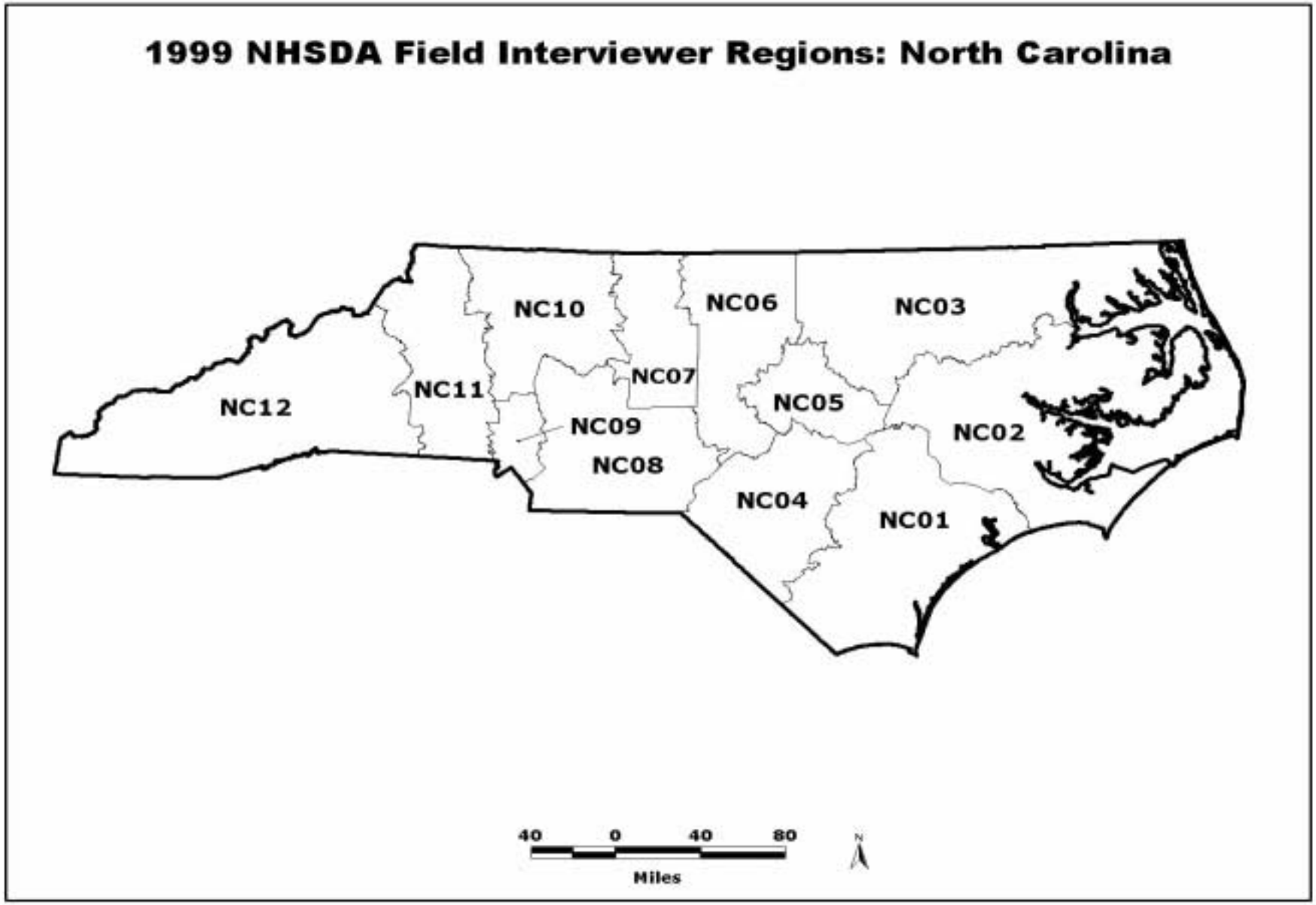
NY13
NY14
NY06
NY07
NY11
NY12
NY03
NY04
NY02
NY08
NY16
NY10
NY05
NY17
NY01
NY15
NY09
NY19
NY18
NY48
NY20
NY22
NY21
30 0 30 60
Miles

1999 NHSDA Field Interviewer Regions: New York City Area Insets

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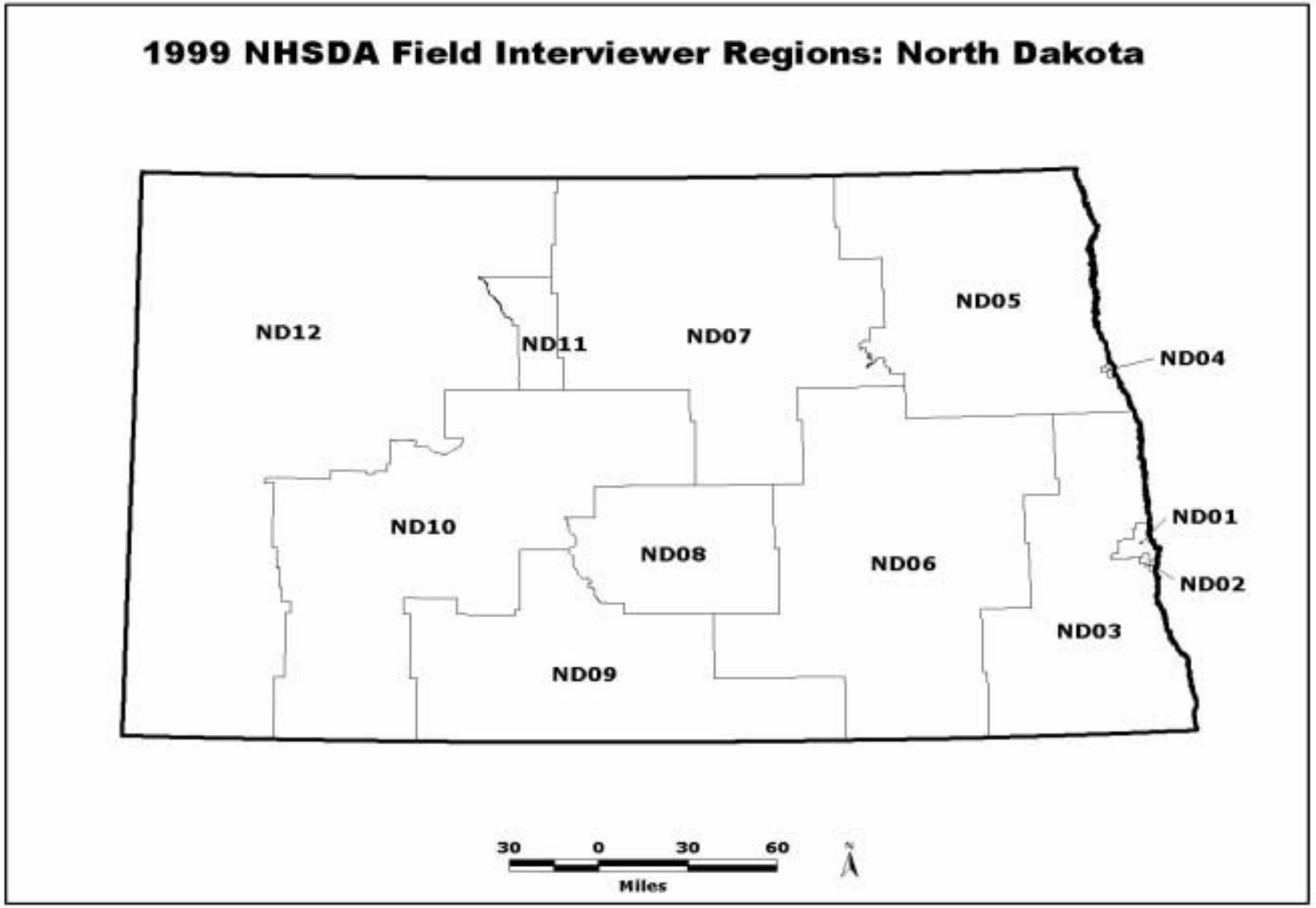
NC12
NC11
NC10
NC09
NC08
NC07
NC06
NC05
NC04
NC03
NC02
NC01
40
0
40
80
Miles
N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ND12
ND11
ND07
ND05
ND04
ND10
ND08
ND06
ND01
ND02
ND03
ND09
30
0
30
60
Miles
N

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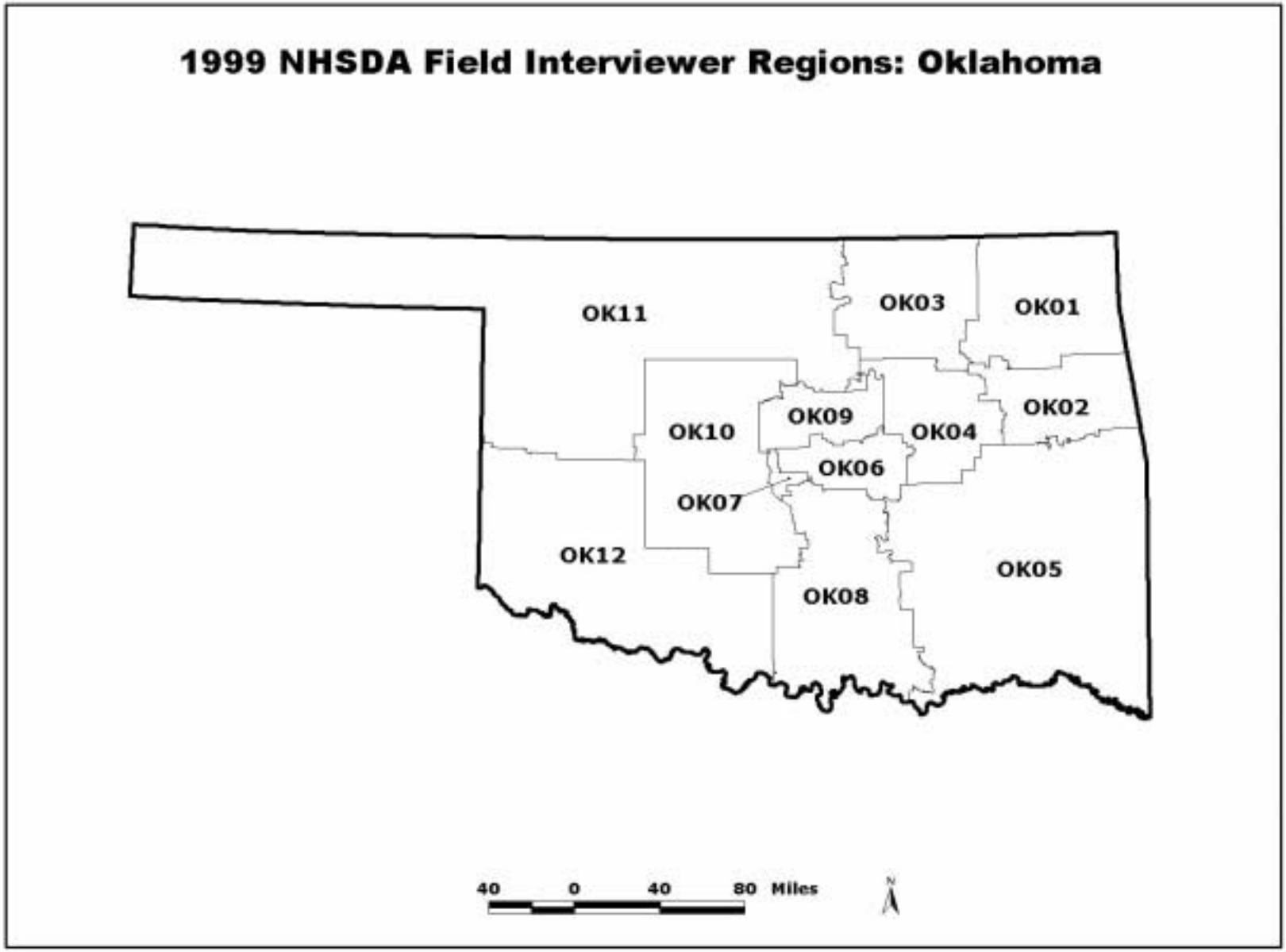
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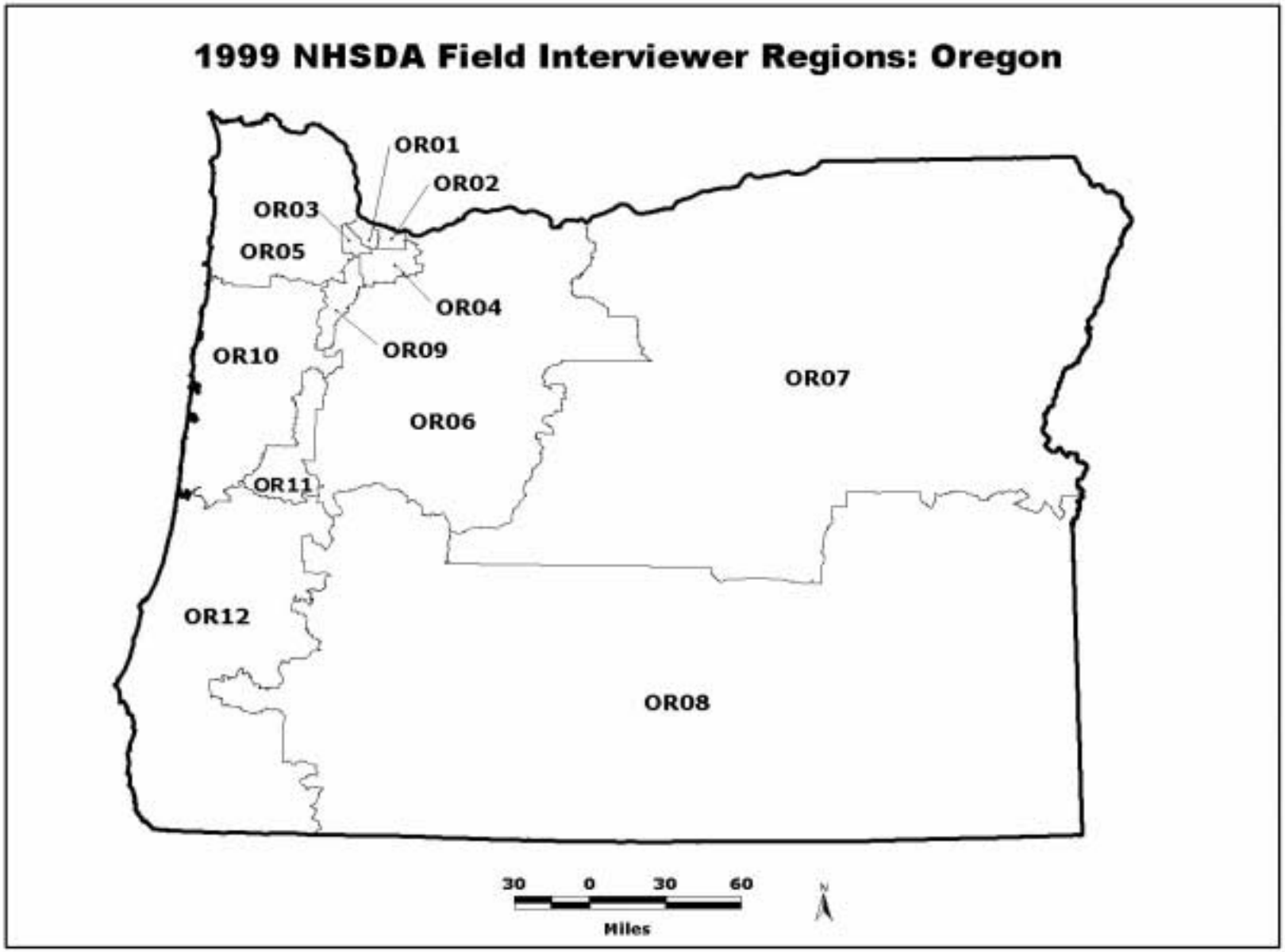
OK03
OK01
OK10
OK09
OK04
OK02
OK06
OK07
OK12
OK08
OK05
40 0 40 80 Miles
N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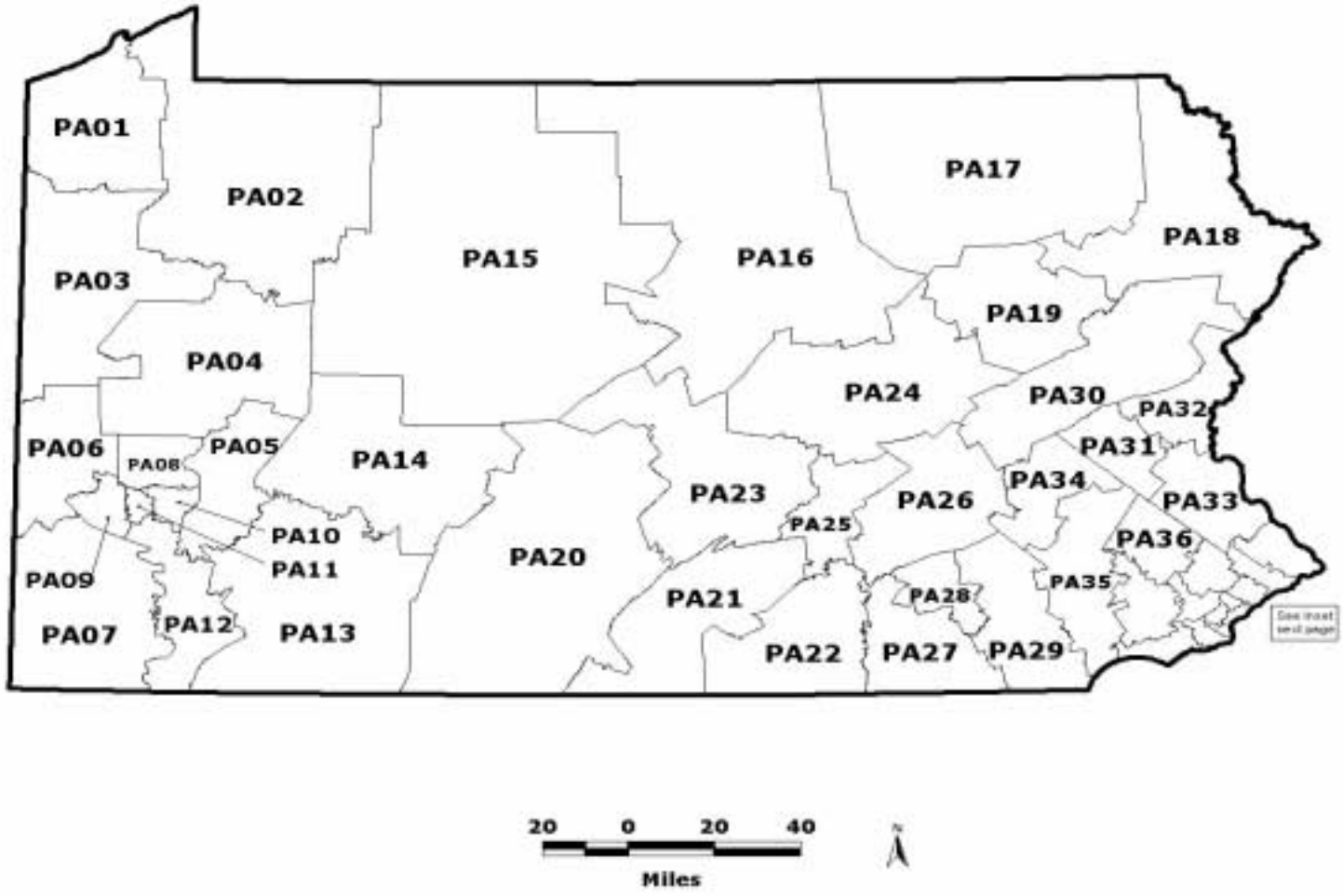
OR01
OR02
OR03
OR05
OR04
OR10
OR09
OR07
OR06
OR11
OR12
OR08
30
0
30
60
Miles
N

1999 NHSDA Field Interviewer Regions: Pennsylvania



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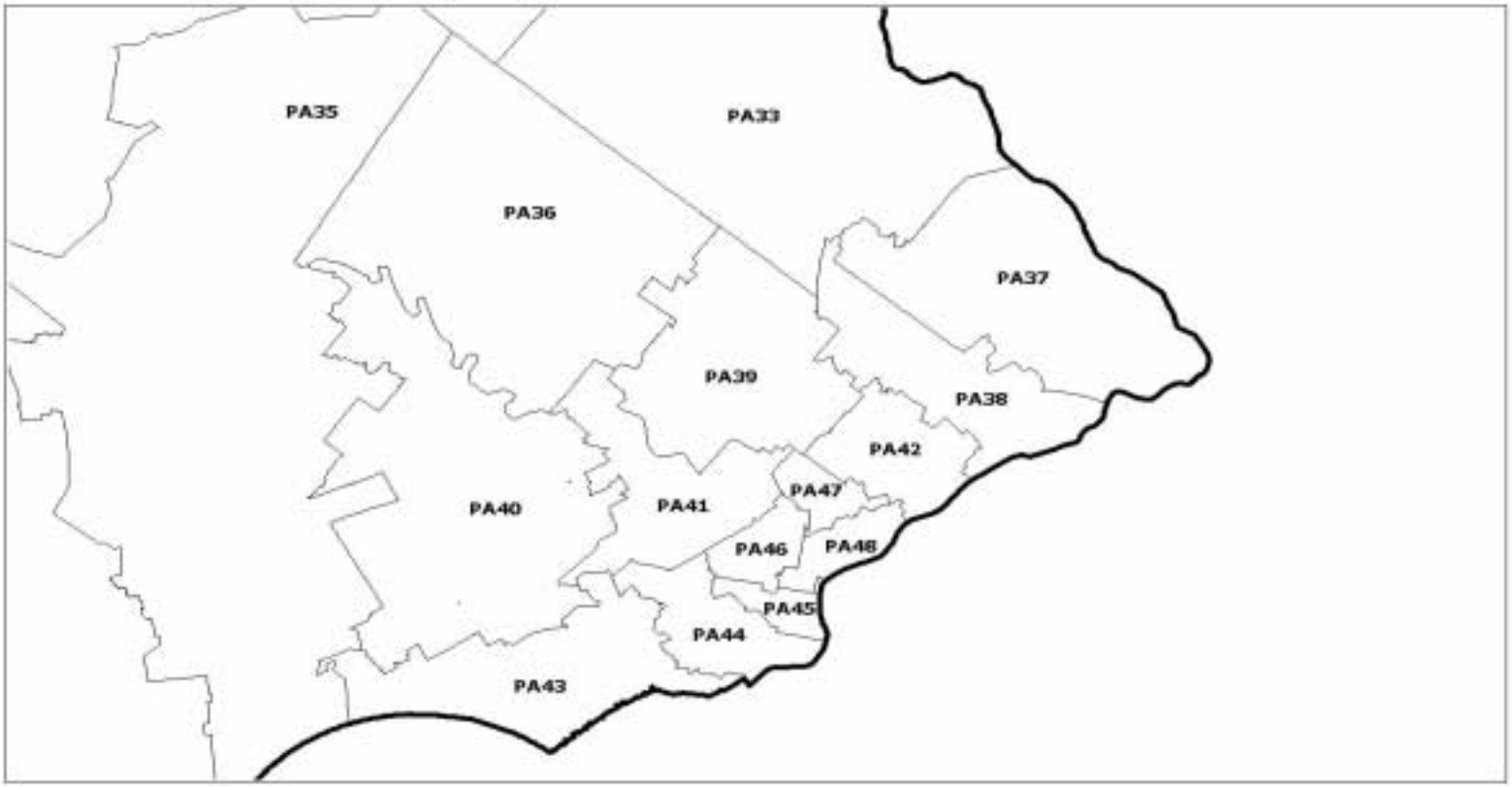

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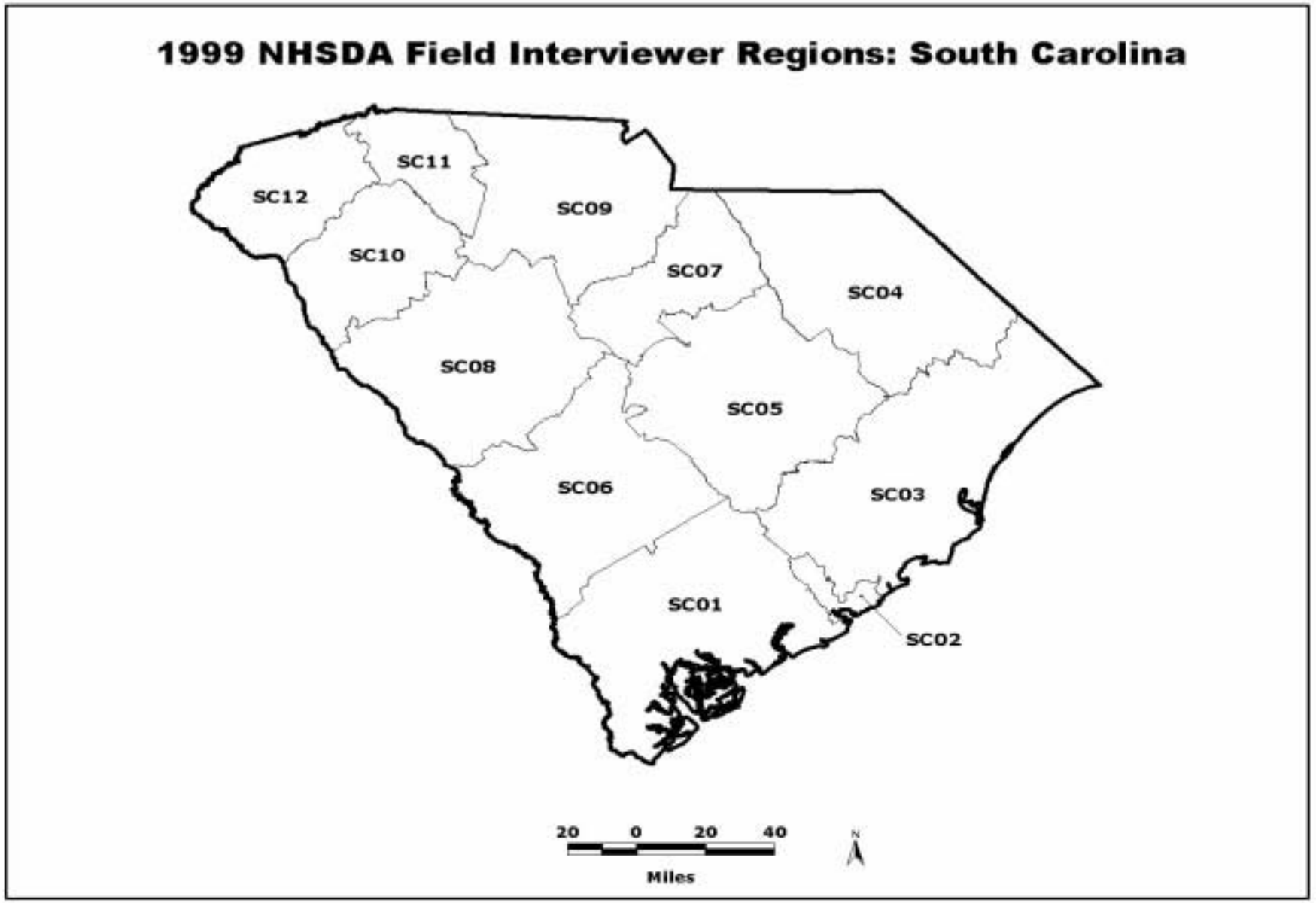
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SC11
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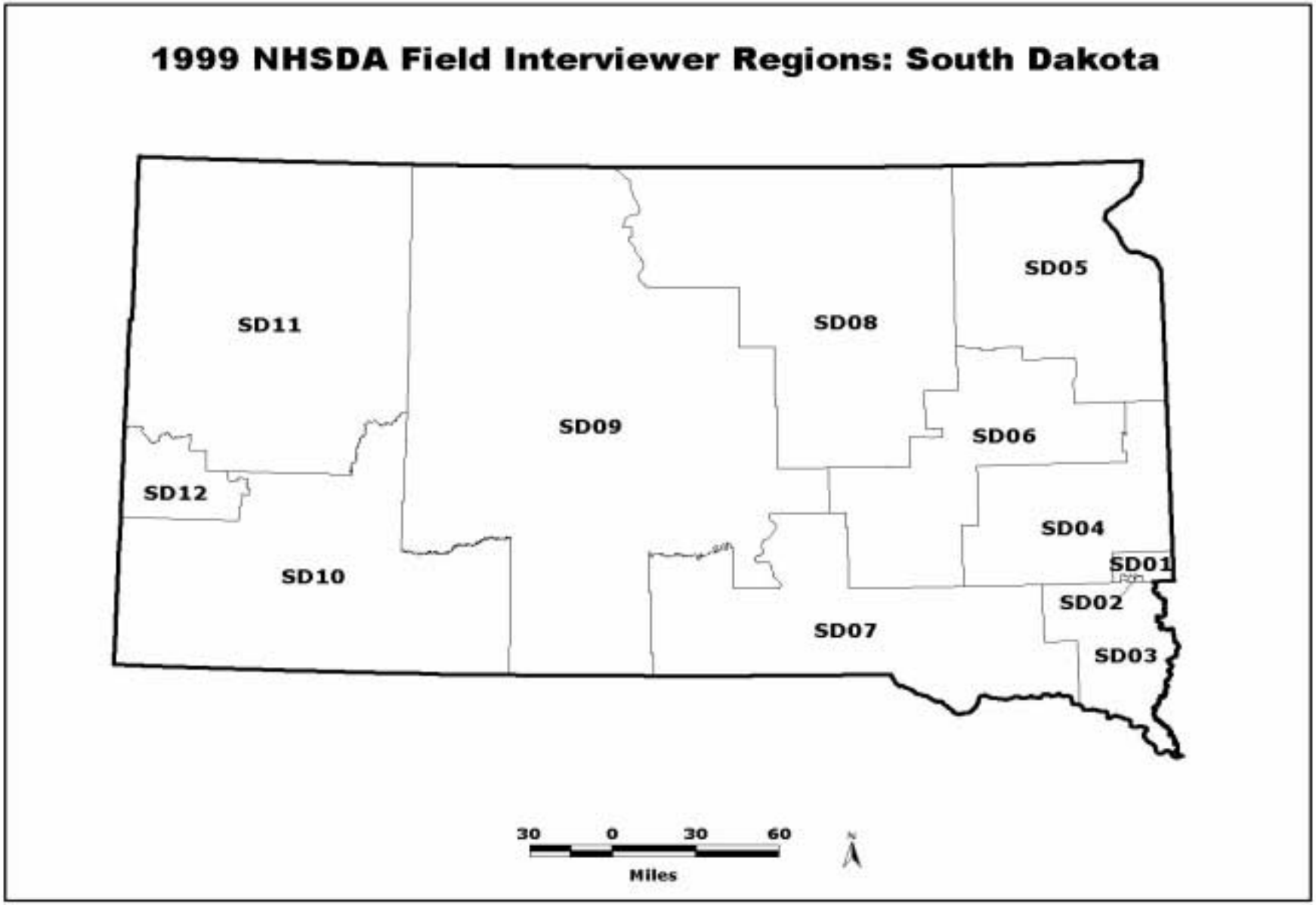
SC09
SC10
SC07
SC04
SC08
SC05
SC06
SC03
SC01
SC02
20 0 20 40
Miles
N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SD11
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SD09
SD06
SD12
SD04
SD01
SD10
SD02
SD07
SD03
30
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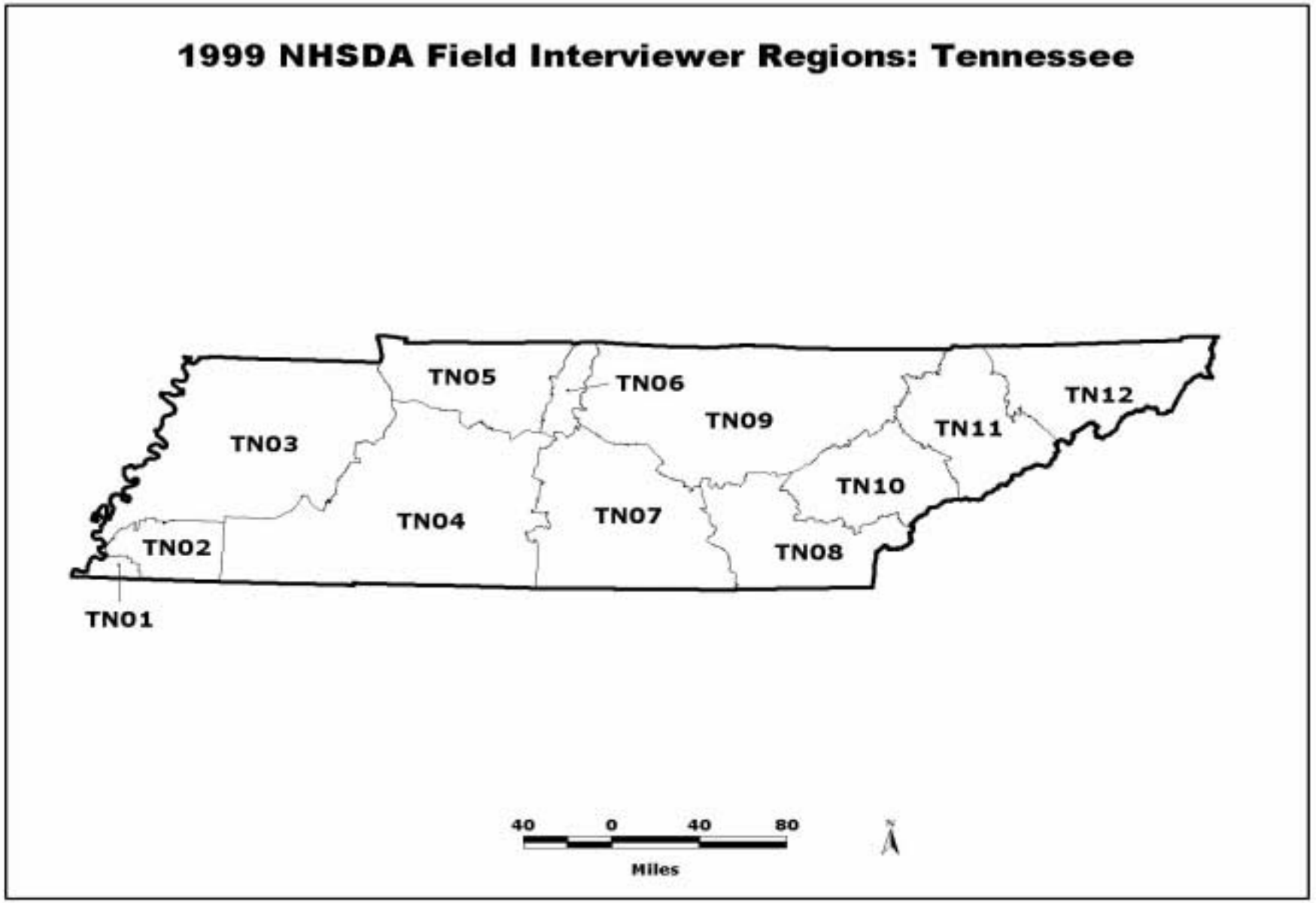
30
60
Miles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TN01
TN02
TN03
TN04
TN05
TN06
TN07
TN08
TN09
TN10
TN11
TN12
40
0
40
80
Miles


1999 NHSDA Field Interviewer Regions: Texas
TX48
TX47
TX46
TX45
TX37
TX35
TX36
TX28
TX31
TX32
TX33
TX34
TX29
TX30
TX21
TX20
TX27
TX25
TX23
TX26
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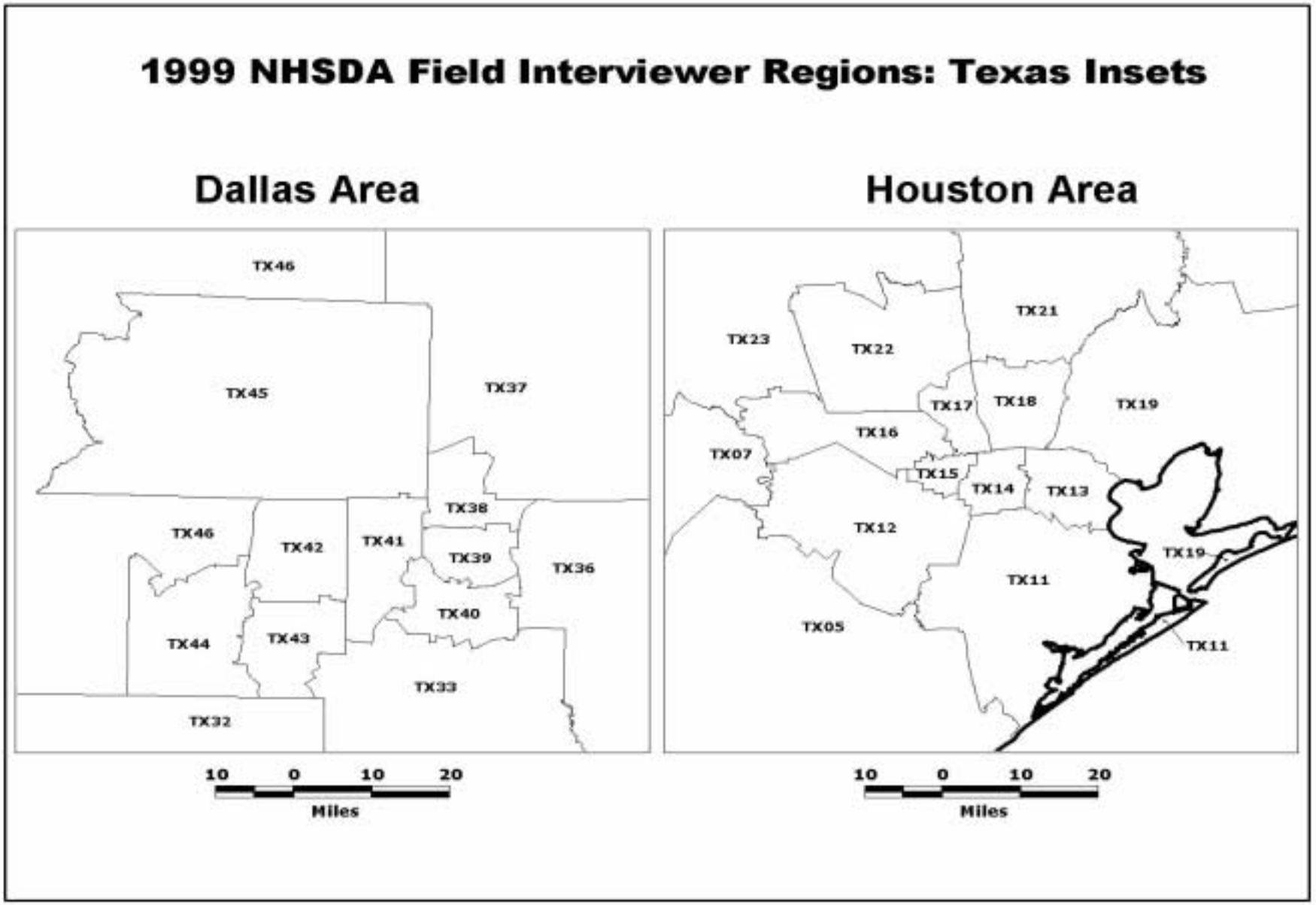
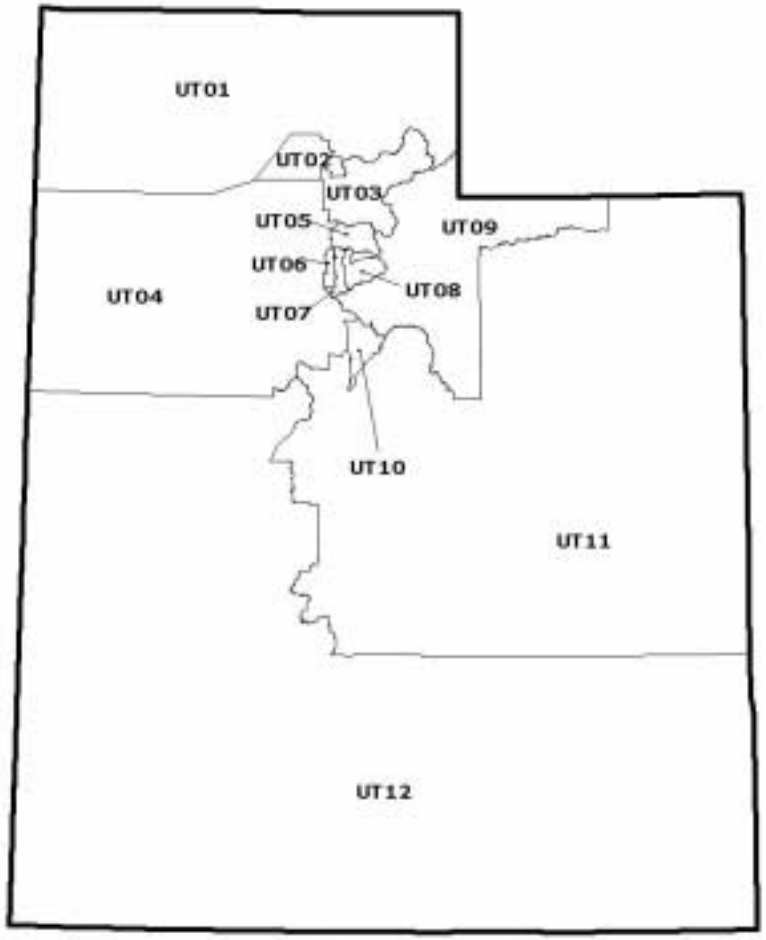
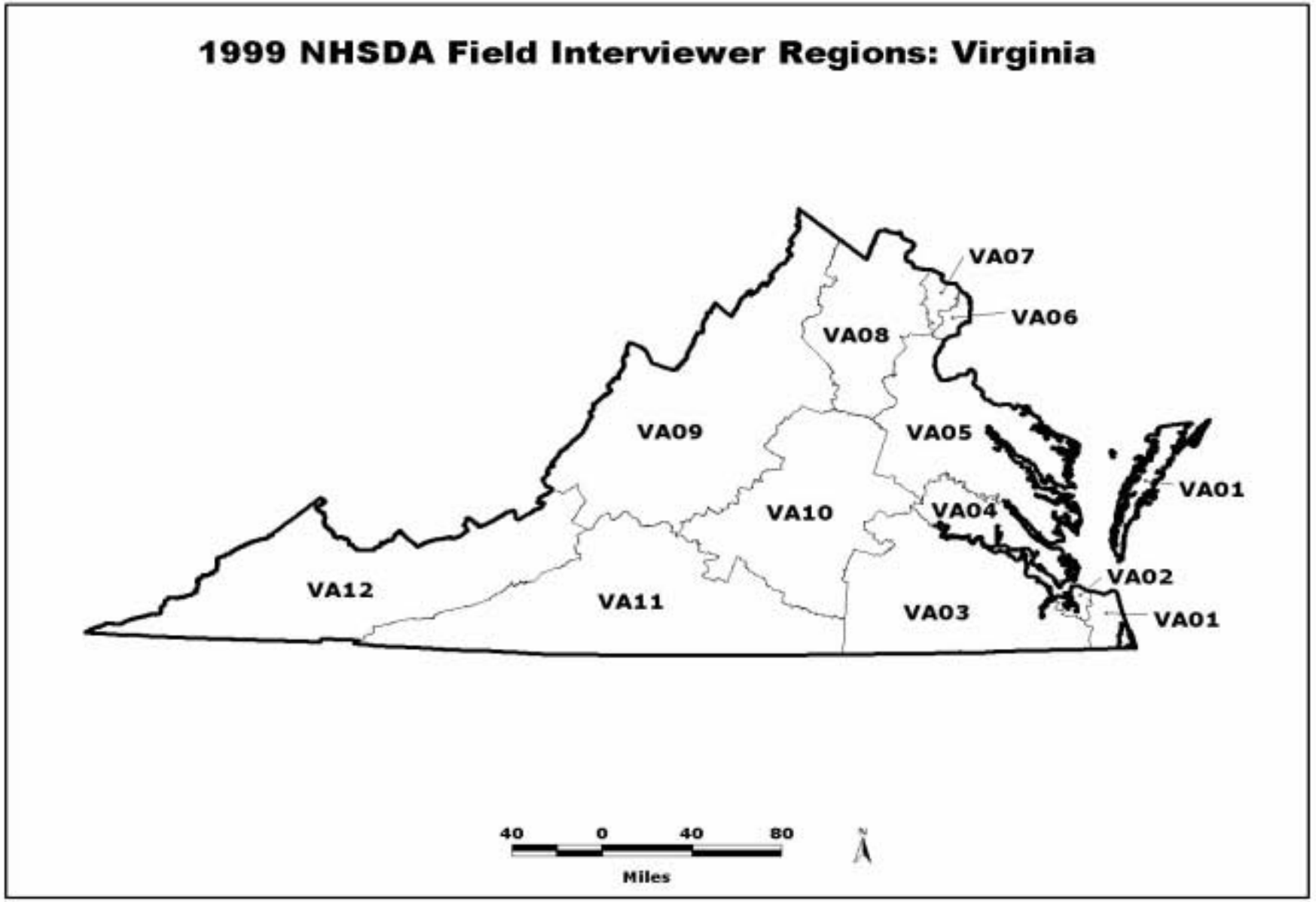
TX04
TX03
TX02
TX01
80 0 80 160
Miles
N

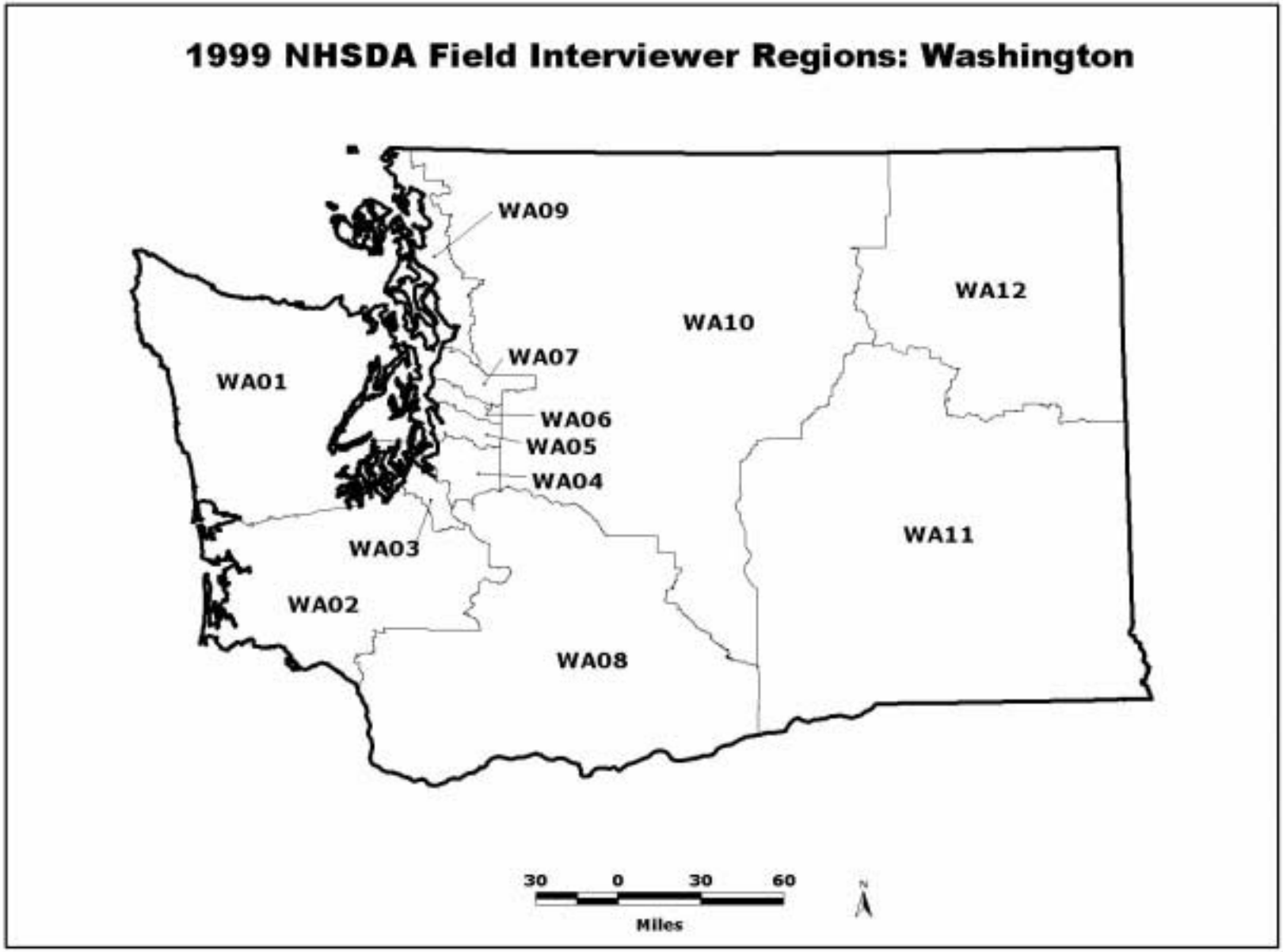

1999 NHSDA Field Interviewer Regions: Texas Insets
Dallas Area
TX46
TX45
TX37
TX38
TX46
TX42
TX41
TX39
TX36
TX44
TX43
TX40
TX33
TX32
10 0 10 20
Miles
Houston Area
TX21
TX23
TX22
TX17
TX18
TX19
TX16
TX07
TX15
TX14
TX13
TX12
TX19
TX11
TX05
TX11
10 0 10 20
Miles

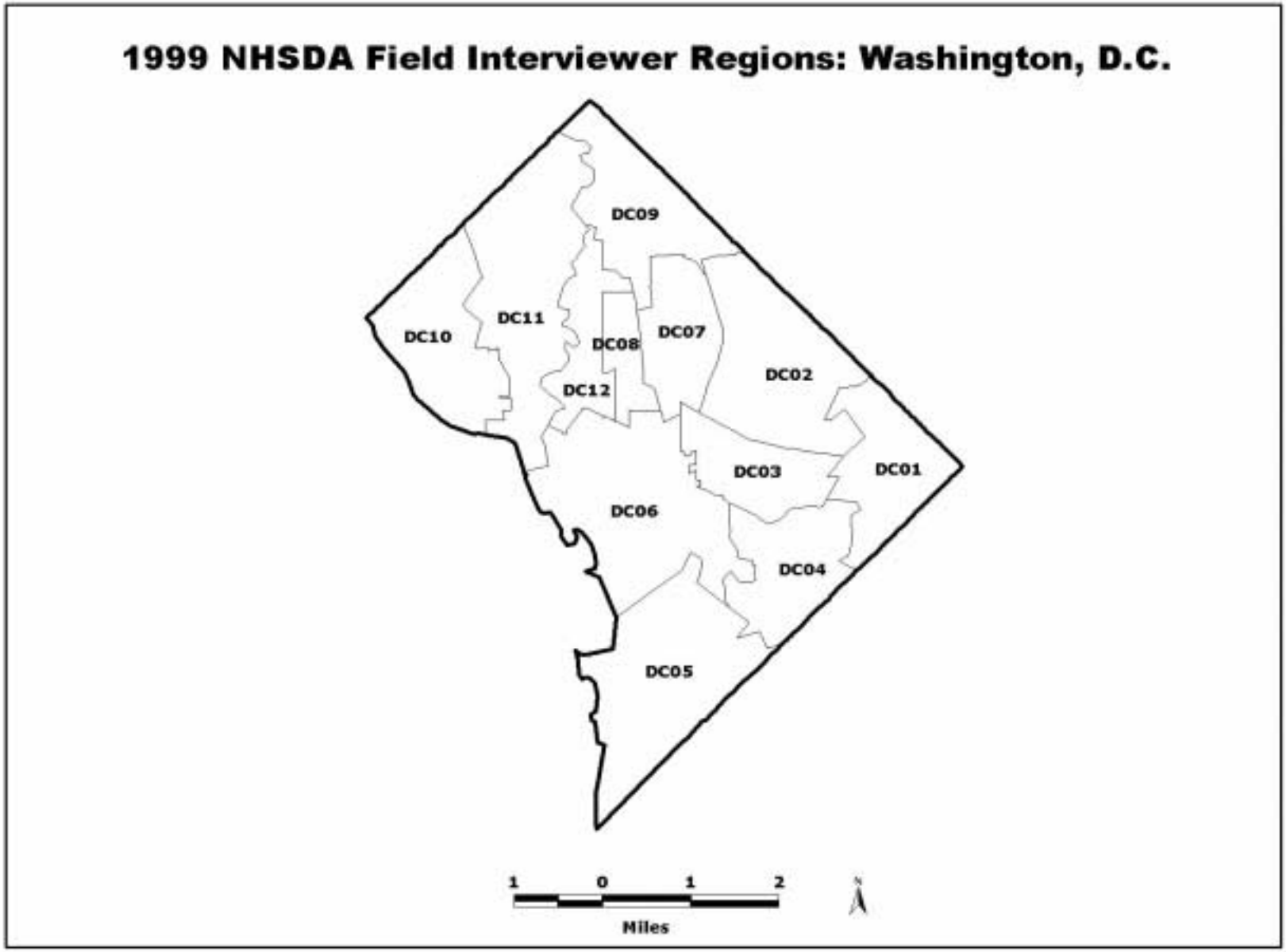
1999 NHSDA Field Interviewer Regions: Utah

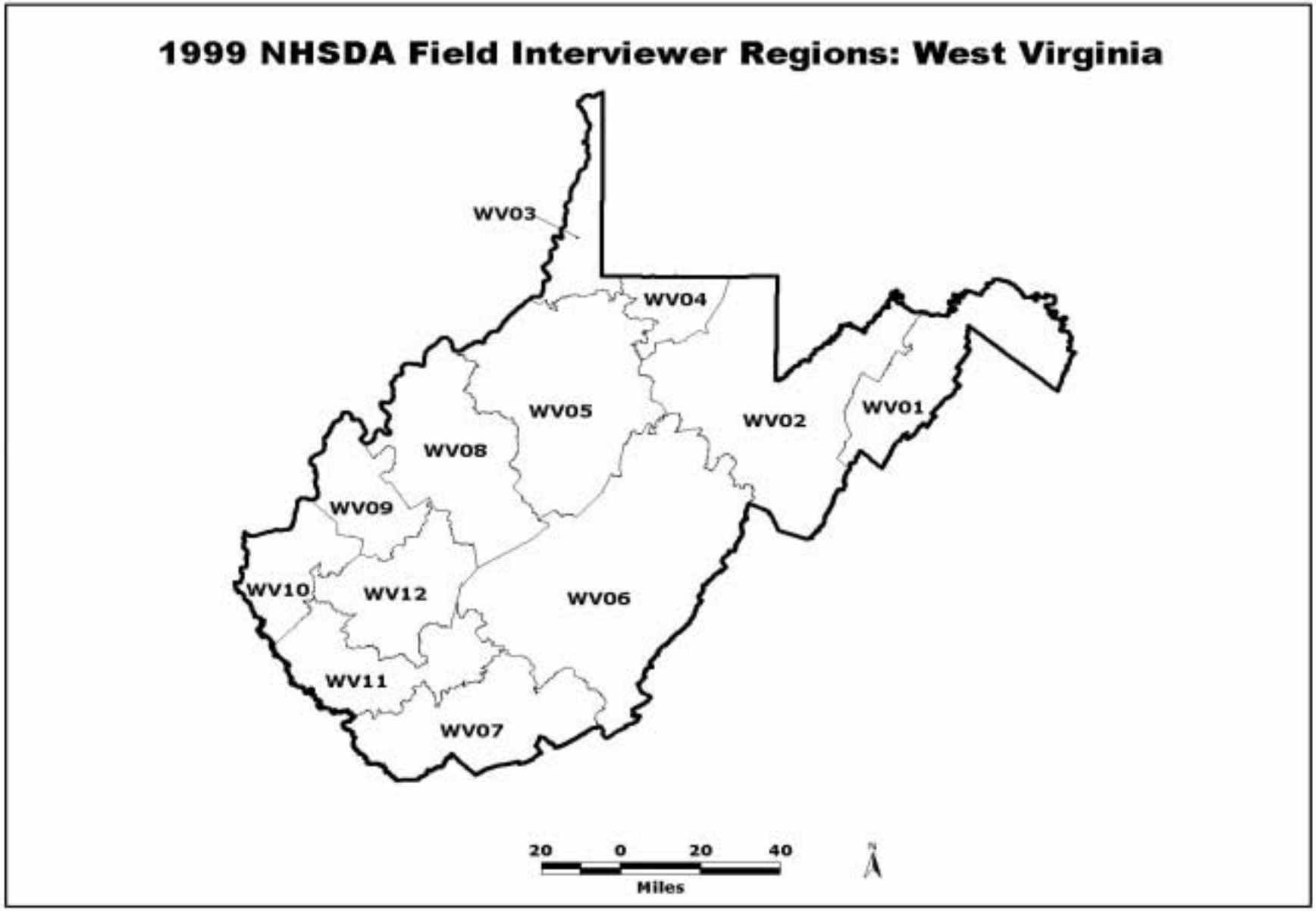


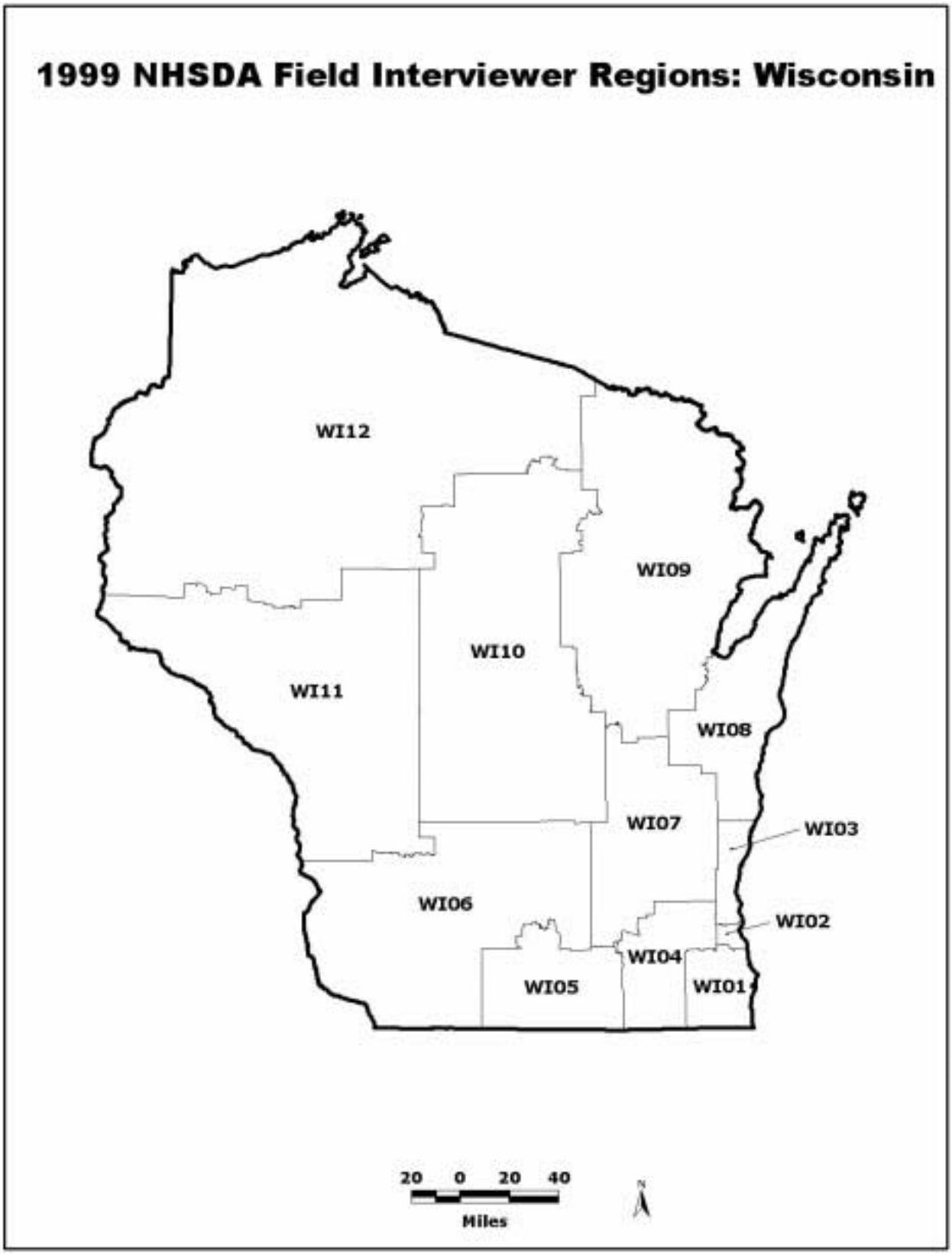
1999 NHSDA Field Interviewer Regions: Vermont

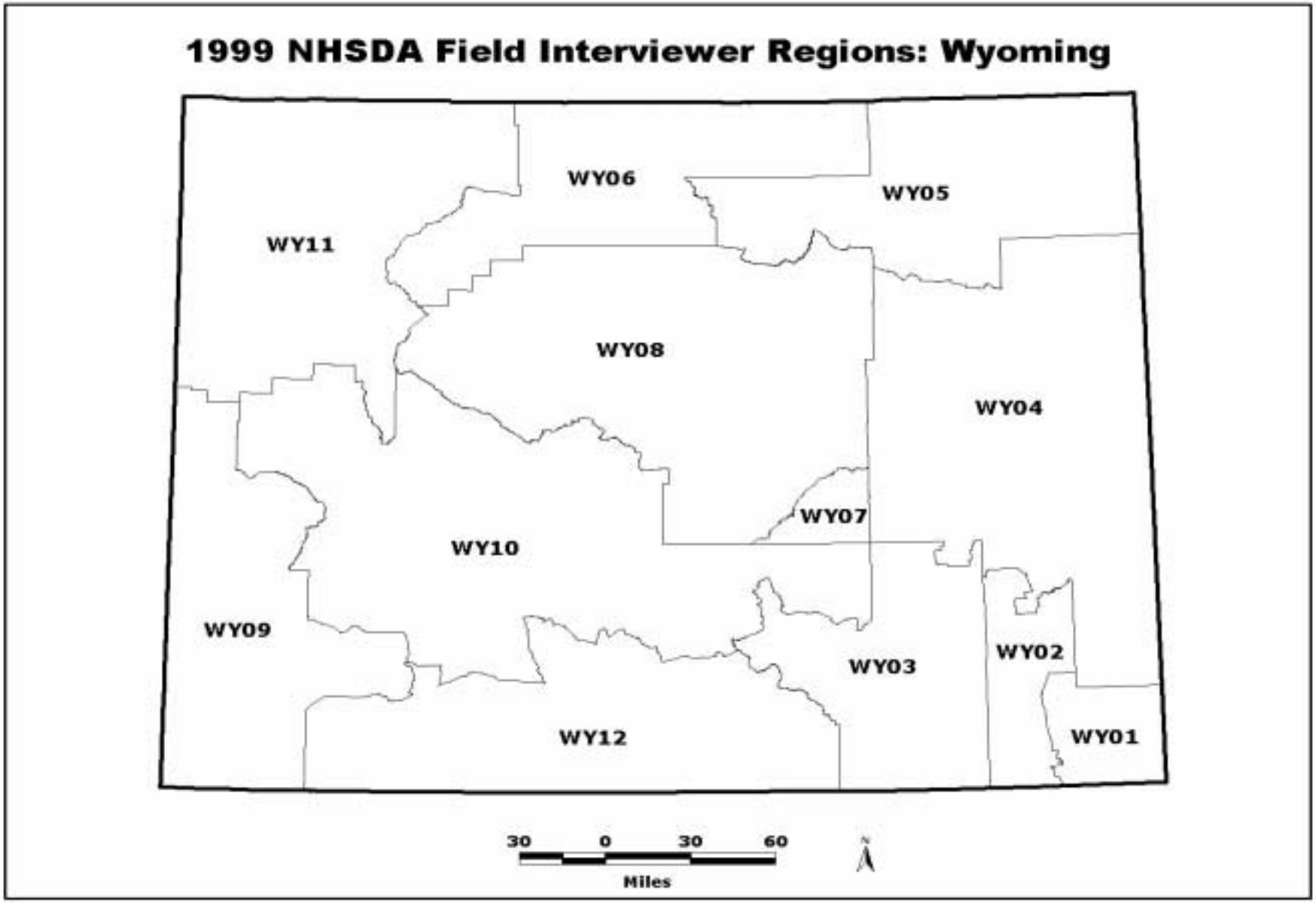

1999 NHSDA Field Interviewer Regions: Virginia
VA07
VA06
VA08
VA09
VA05
VA01
VA10
VA04
VA02
VA12
VA11
VA03
VA01
40
0
40
80
Miles


1999 NHSDA Field Interviewer Regions: Washington
WA09
WA10
WA12
WA07
WA01
WA06
WA05
WA04
WA11
WA03
WA02
WA08
30
0
30
60
Miles
N


1999 NHSDA Field Interviewer Regions: Washington, D.C.
DC09
DC10
DC11
DC08
DC07
DC12
DC02
DC03
DC01
DC06
DC04
DC05
1
0
1
2
Miles
N


1999 NHSDA Field Interviewer Regions: West Virginia
WV03
WV04
WV05
WV02
WV01
WV08
WV09
WV10
WV12
WV06
WV11
WV07
20
0
20
40
Miles
N


1999 NHSDA Field Interviewer Regions: Wisconsin
WI12
WI09
WI10
WI11
WI08
WI07
WI03
WI06
WI02
WI04
WI05
WI01
20 0 20 40
Miles
N


1999 NHSDA Field Interviewer Regions: Wyoming
WY06
WY05
WY11
WY08
WY04
WY07
WY10
WY09
WY03
WY02
WY12
WY01
30
0
30
60
Miles
N

Appendix B

1999 NHSDA Quarter 1 Subsampling Procedures

1. PAPI Selection Probability Corrections

Excessive yields from PAPI screenings were observed and the problem was identified early in quarter 1 of the 1999 NHSDA. The probable cause of the problem was identified to be the Newton using the wrong household type probability selection vectors; this was later confirmed for 417 of the 500 quarter 1 PAPI segments. A plan was initiated to pull all PAPI cases with screening result codes less than 10 (i.e., not finalized) and corrected selection probability vectors would be transmitted back to the Newtons after appropriate corrections had been made. In order to compensate for the excessive yields, the selection probabilities on pending cases were reduced by a factor of 0.50 for the white household type, and by a factor of 0.80 for the black household type. Selection probabilities for Hispanic household types were left at their correct targeted values. For weighting purposes, the actual person selection probabilities used to select the sample persons were maintained in the control system.

2. Yield Reduction 1

Midway through quarter 1, it became apparent that more sample had been put in the field than could possibly be completed. Thus, a further sample reduction was implemented. Only pending screening cases were subsampled and at a rate of 1/3 retained. The process involved trying to get all field interviewers to transmit their current status codes and then removing a sample of pending cases based on the control system status at a set time (time 1). On the next transmit (time 2) cases sampled out were removed from the field interviewer's Newton. Any cases that had achieved a final screening status code (response or nonresponse) between time 1 and time 2 were put back on the field interviewer's Newton at the next transmission (time 3). A special flag was set up to identify cases in the following categories:

0 Not subject to subsampling at this round
2 Subject to subsampling and retained at time 1
3 Subject to subsampling and dropped out at time 1
4 Code 2 and code 3 cases, finalized between time 1 and time 2 and put back on the field interviewer's Newton. (Actually only code 3s were recoded to a code 4 when they were put back.)

In order to determine which cases were finalized between times 1 and 2, control system snapshots were taken of all cases eligible to be sampled at time 1, and the screening codes were retained for weighting purposes. **Table 1** shows the results of the sampling process. The time 2 snapshot, however, reflects the status as of the cutoff date and does not reflect the counts at the various times at which the transmissions for removing the sampled out cases occurred. These actually occurred on a flow basis. Of the 238 cases finalized among the sampled out cases, 44 were code 31s (one person selected) and 13 were code 32s (two persons selected). The flagging did not identify the retained cases that changed status from pending to final during the same period, but 640 retained cases that changed screening status from pending to complete by the cutoff date were identified. Rather than drop these finalized screenings, an approximate weight correction for the comparable portions of the dropped and retained sample was recommended. **Table 1a** and **Table 1b** show that use of an intermediate weight (between 1 and 3) allows the

retaining of all cases completed during the subsampling period and still preserves the initial sample representation based on the subsampling weight factors.

Table 1a. First Subsample of Pending Screening Cases (Preliminary Tabulations): Quarter 1 CAI

Time 1 action	Number	Time 2 status	Number	Weight factor	Weighted number
Pending screening dropped from sample	8,791	Still pending (codes 00-09)	8,640	0.00000	0
		Finalized (codes 10-32)	151	1.00000	151
Pending screening retained in sample	4,370	Still pending (codes 00-09)	3,997	3.01167	12,038
		Finalized (codes 10-32)	373	2.60684	972
Subtotal	13,161		13,161		13,161
Screening finalized	40,193	Still finalized	40,193	1.00000	40,193
Overall total	53,354		53,354		53,354

Table 1b. First Subsample of Pending Screening Cases (Preliminary Tabulations): Quarter 1 PAPI

Time 1 action	Number	Time 2 status	Number	Weight factor	Weighted number
Pending screening dropped from sample	5,571	Still pending (codes 00-09)	5,484	0.00000	0
		Finalized (codes 10-32)	87	1.00000	87
Pending screening retained in sample	2,730	Still pending (codes 00-09)	2,463	3.01167	7,418
		Finalized (codes 10-32)	267	2.98223	796
Subtotal	8,301		8,301		8,301
Screening finalized	17,664	Still finalized	17,664	1.00000	17,664
Overall total	25,965		25,965		25,965

This process did not achieve a 1/3 pending sample retention at time 2 because the sampling was done at time 1. The weight approximation allows the retaining of all work completed up to time 2. If an interviewer did not call in until much later (after a cutoff date), then her/his cases were never subsampled and all those initially subsampled out became code 4s and received the intermediate weight.

Since the procedure employed subsampling of pending screenings (not all pending screenings and interviews as erroneously projected), it did not adequately reduce the number of remaining cases to allow completion of quarter 1 assignments prior to the end of the quarter. It also appeared that no reasonable subsampling rate would have allowed us to adequately reduce the remaining quarter 1 workload without resorting to subsampling some screened SDUs with pending interviews. As a result, a second round of yield reductions was required and was implemented a few weeks later.

3. Yield Reduction 2

This step was implemented on March 18 following further discussions with SAMHSA about options remaining to effectively reduce sample yield without adversely affecting the response rates. With a few exceptions, this round of reductions reduced both pending screening cases and pending interview cases by 1/2. Subsampling was implemented at the SDU level, but in some cases SDUs removed from further followup included one completed interview (which would be retained for analysis purposes) and one pending interview (which was subject to the subsampling process). SDUs subject to the subsampling procedure included:

(1) All SDUs with screening codes 01 through 09
(2) All SDUs with screening code 31 (one persons selected) and a pending interview code 51-59.
(3) All SDUs with screening code 32 (two persons selected) and both with pending interview codes in the 51-59 range
(4) All SDUs with screening code 32, a finalized interview code (70-79) for one person and a pending interview code 51-59 for the other person.

Note that those SDUs with a completed screening code 31 or 32 and a pending appointment code (code 50) for one or both selected persons were not subject to subsampling since we did not want field interviewers to break any appointments as a result of this process.[1] **Table 2** shows the four categories eligible for subsampling and three additional categories that were not eligible for subsampling.

The subsampling occurred at time 1 and retained ½ of the cases in each of the four categories above. At time 2 some cases were put back onto the field interviewer's Newton because they had reached a final interview status during the interim.

[1]A total of 97 SDUs had one person with a 50 code and another person with a code in the 51-59 range and all were retained.

Table 2. Sampling Eligibility by Category at First Snapshot

Category	Screening status	Interview status	Interview status	Eligible
1	Pending screening (00-09)	--	--	Yes
2	One person selected (31)	Pending exc. appt. (blank, 51-59)	--	Yes
3	Two persons selected (32)	Pending exc. appt. (blank, 51-59	Pending exc. appt. (blank, 51-59)	Yes
4	Two persons selected (32)	Final or appt. (50, 70-79)	Pending exc. appt. (blank, 51-59)	Yes
5	One person selected (31)	Final or appt. (50, 70-79)		No
6	Two persons selected (32)	Final or appt. (50, 70-79)	Final or appt. (50, 70-79)	No
7	Final screening, no one selected (10-30)	--	--	No

Table 3 shows the actions and flag setting at time 2.

Table 3. Actions When Picking up Cases (as Field Interviewers Transmit from Newtons) after Sampling (Applies to Sampled Out Cases Only)

Category	Action	Flag
1	None	3
2	None	3
3	None	3
4	Keep final or appt., code other as 76, put back on Newton	5
5	Keep, put back	4
6	Keep, put back	4
7	Keep, put back	4

Table 4a and **Table 4b** show the weighting factors used which preserve the initial sample representation.

Table 4a. Round 2 Subsample: Quarter 1 CAI

Time 1 Action	Number	Time 2 category	Number	Weight Factor		Weighted DUs
				DU	Person	
Dropped from sample	4,044	1	1,827	1.00000	1	1,827
		2 or 3	1,814	0.00000	0	0
		4	317	1.00000	2	317
		5, 6, or 7	86	1.00000	1	86
Retained in sample	4,030	1	1,499	1.00000	1	1,499
		2 or 3	1,672	1.87594	1	3,137
		4	290	1.40679	1	408
		5, 6, or 7	569	1.40679	1	800
Total eligible	8,074		8,074			8,074
Not eligible for subsampling	45,280	5, 6, or 7	45,280	1.00000	1	45,280
Total	53,354		53,354			53,354

Table 4b. Round 2 Subsample: Quarter 1 PAPI

Time 1 Action	Number	Time 2 category	Number	Weight Factor		Weighted DUs
				DU	Person	
Dropped from sample	2,160	1, 2, or 3	1,959	0.00000	0	0
		4	157	1.00000	2	157
		5, 6, or 7	44	1.00000	1	44
Retained in sample	2,143	1, 2, or 3	1,630	2.00793	1	3,273
		4	162	1.61612	1	262
		5, 6, or 7	351	1.61612	1	567
Total eligible	4,303		4,303			4,303
Not eligible for subsampling	21,662	5, 6, or 7	21,662	1.00000	1	21,662
Total	25,965		25,965			25,965

4. Putting Back CAI Cases in Quarter 2

In order to reduce the effect of unequal weights, all pending dwelling units (all units from round 1 and 1,827 units from round 2) for the CAI sample were put back into the sample in quarter 2. This putting back of cases resulted in a total of 1,695 respondents who were assigned to quarter 1 but were fielded in quarter 2. No subsampled PAPI dwelling units were put back in quarter 2. The sample weights were adjusted to reflect the subsampling and putting back of cases for both samples.

Appendix C

1999 NHSDA Procedure for Adding Missed Dwelling Units

1. Introduction

The 1999 National Household Survey on Drug Abuse (NHSDA) requires field interviewers (FIs) to visit sample segments and screen and interview dwelling units (DUs) that were selected from an ordered list. The list of DUs, which includes housing units and group quarters, was constructed by the counting and listing staff during the summer and fall of 1998. Because the listing was done a short time before the 1999 screening and interviewing activities began, one would hope that no major discrepancies would be found. However, factors such as new construction, demolition, and inaccurate listing may be present in some cases. More commonly, DUs may have been "hidden" and therefore overlooked by the counter and lister.

In order for all DUs to be given a chance of being selected, the NHSDA has in place a procedure for locating and adding missed DUs. The current procedure requires FIs to look both on the property of selected DUs and between that DU and the next listed DU (half-open interval rule). If the number of added DUs linked to any particular DU does not exceed three or if the number for the entire segment is less than or equal to six, the FI is instructed to consider these DUs as part of their assignment. However, if either of these limits is exceeded, the FI will contact RTI for subsampling to be considered.

This document outlines the proposed procedures for RTI to use when discrepant segments are found in the field. For the purposes of this document, procedures for adding missed DUs will be classified into three categories: adding housing units (HUs), adding group quarter units, and "busts."

2. Motivation

In previous years, if the number of added DUs exceeded three for the DU or six for the segment, the added DUs were subsampled at the same rate of the original selection for the segment. In order to maintain unequal weighting effect and to control costs associated with adding DUs, a new subsampling procedure is proposed:

Number of Added DUs	Sampling Rate
0	No Action
1-6	Automatic (all DUs added to the sample)
7-10	1 (take all)
11-25	½
26-40	1/3
41-50	¼
50+	1/5

3. Procedure for Adding Housing Units

This section refers to housing units that are obtained through the half-open interval rule. This method of dealing with added HUs is preferable to all others because it is probability-based and maintains the integrity of the sample. When possible, this methodology will be used to resolve added DU problems.

1. Once the limit of three (or six) rule is exceeded, the FI should stop Screening and Interviewing activities on added HUs and contact RTI. The FI will be instructed to do a quick check of the segment to see if any other listing problems might arise. At this time, the FI will complete a paper list of added HUs for the entire segment.

2. Once the final list of added HUs has been received by RTI:

    a) Sampling will examine the added HUs and determine whether they are linked to a sample dwelling unit (SDU).
    b) If the number of added HUs linked to any SDU exceeds 50, these units will be treated as a "bust." (See Section 6)
    c) If the number of added HUs linked to any one non-sampled DU exceeds 50, these units will also be treated using the procedure for "busts." (see Section 6)
    d) Sampling will calculate the total number of added DUs by adding the number of sampling units obtained through the "bust" procedure to the number of added DUs obtained through the half-open interval rule.
    e) If the total number of added DUs exceeds 10, a subsampling rate will be determined using the criteria above.

3. RTI will add the HUs to the system and subsample if necessary:

    a) Data entry of the added HUs will be done. Lines will be entered for all units that collectively qualify as a "bust" and units obtained through the half-open interval rule, and not for all missed DUs found in the segment. At this time, the link number will be entered and a line number will be assigned. For lines obtained through the "bust" procedure the SLN or sampling link number will also be recorded. Finally, it will be necessary to check that none of the lines have already been entered in the Newton so that lines don't appear in the system twice.
    b) Select lines from the added HUs at the rate defined above. Record the subsampling rate in a data field.
    c) For all cases that have no CAI or PAPI assignment (i.e. added HUs that were not previously entered in the FI's Newton), assign CAI or PAPI at the same rate as for the entire segment.
    d) Bring over CAI or PAPI probabilities of selection as appropriate for the segment.
    e) Add a random number for the Newton selection algorithm.

4. Selected lines will be added to the FI's assignment during the next transmission.

4. Procedure for Adding Group Quarter Structures

In the case of an entire group quarter structure not being listed (or erroneously being listed as a HU), the half-open interval rule will be applied. For example, if the DU preceding the GQ was selected or if the HU that is really a GQ was selected, the entire GQ structure will be

added to the sample. The exception to this rule will be if the number of GQ units in the missed GQ structure exceeds 50. In this last case, the "bust" procedure will be applied (see Section 6).

5. Procedure for Adding Group Quarter Units

In the case of discrepant GQ listings, we will know in advance the number of sampling units (rooms, persons, or beds) and the number of selected units. If the actual number of sampling units equals the amount listed in advance, the Newton will only need to be notified of the new unit type in order to function properly. However, if the actual units do not equal the advance units, two approaches will be taken.

5.1. Number of Actual GQ Units Less Than Number of Advance GQ Units

In the case that there are extra GQ units listed, the units at the end of the list will be assigned an ineligible code such as "Not A DU." All other units will remain eligible.

5.2. Number of Actual GQ Units Greater Than Number of Advance GQ Units

If there are more GQ units in the structure than were previously listed, a complete list will be made and the units will be consecutively numbered. Assume, for example, that 11 units were listed and 45 were actually found. Also, assume that units 1, 5, and 10 were selected for Screening and Interviewing.

Original list:
1
2
3
4
5
6
7
8
9
10
11

Then, the additional units will be numbered consecutively and a Sampling Link Number (SLN) corresponding to each of the originally listed units will be assigned. Next, the added GQ units with SLNs corresponding to the original selected units will be added to the sample. The new sampled unit will be assigned the same method, CAI or PAPI, as the originally selected unit.

Unit Number	SLN
12	**1**
13	2
14	3
15	4

16	**5**
17	6
18	7
19	8
20	9
21	**10**
22	11
23	**1**
24	2
25	3
26	4
27	**5**
28	6
29	7
30	8
31	9
32	**10**
33	11
34	**1**
35	2
36	3
37	4
38	**5**
39	6
40	7
41	8
42	9
43	**10**
44	11
45	**1**

6. "Busts"

Any segment listing with a major discrepancy (defined by 50 or more unlisted units or 50 or more added DUs linked to an SDU) or that is completely unrepresentative of what is actually found is called a "bust." In the case of a fictitious listing, RTI will relist the segment as quickly as possible. Otherwise, the following approach will be employed. First, if any DUs have disappeared since the time of the listing, all selected "disappears" will be assigned an "ineligible" Final Screening Code. Then, any new DUs will be listed consecutively, assigned a SLN, and added to the sample if the SLN corresponds to the line number of an originally selected DU. CAI or PAPI for the new sampled DU will be taken from the originally selected unit. Note that if the DU was coded "ineligible" in the first step, the new DUs having its line number as the SLN will still be added. This procedure is identical to the procedure for adding extra GQ units, however the list can contain any combination of HUs and GQ units in this case. Again, if the number of DUs added is greater than 6, then resampling will occur from all non-finalized DUs as in Section 3.

7. Quality Control

In order to ensure the quality of the work done, RTI will employ several quality control checks:

1. Mapping will ensure that the correct information has been keyed by data entry.
2. Checks within the computing division.
3. Sampling will check the number of selected lines and the person probabilities of selection assigned to each DU selected in the subsampling routine.